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Guidelines on Fire Fighting, Equipment and Appliances

in Petroleum Industry

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Oil Industry Safety Directorate
Government of India
Ministry of Petroleum & Natural Gas

NOTE

FOREWORD

The oil industry in India is over 100 years old. As such, various practices have been in vogue because of collaboration/association with different foreign companies and governments. Standardisation in design philosophies and operating and maintenance practices at a national level was hardly in existence. This, coupled with feed back from some serious accidents that occurred in the recent past in India and abroad, emphasised the need for the industry to review the existing state of art in designing, operating and maintaining oil and gas installations.

With this in view, the Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by the Oil Industry Safety Directorate (OISD), staffed from within the industry, formulating and implementing a series of self regulatory measures aimed at removing obsolescence, standardising and upgrading the existing standards to ensure safer operations. Accordingly, OISD constituted a number of functional committees comprising of experts nominated from the industry to draw up standards and guidelines on various subjects.

OISD have brought out a number of documents on various topics like layouts of installations, design, engineering, maintenance and operations of various facilities / equipment etc. As petroleum industry is inherently hazardous from fire point of view, fire fighting establishment in the installation is of vital importance. Keeping in view the need to standardise various fire fighting facilities required by the oil industry, OISD have brought out standards on "Fire Protection facilities for Petroleum Refineries and Oil/Gas Processing Plants (OISD-STD-116), "Fire Protection facilities for Petroleum Depots and Terminals (OISD-STD-117), Fire protection facilities for LPG plants OISD-STD-144 & 169 and Inspection of Fire Fighting Equipment and System OISD-STD-142. These documents are in use for providing fire fighting facilities for quite a number of years.

As varieties of fire fighting equipment and fire fighting agents are available , it was getting difficult for the industry to select right type of equipment / fire fighting agent in terms of its quality and performance. To fulfill this requirement, the present document is prepared in the form of Guideline which would be helpful in selecting / procuring right types of fire fighting materials / equipment.

This document will be reviewed periodically for improvements based on the experience and better understanding.

Suggestions from industry members may be addressed to :

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(In addition to the above, several other experts from industry contributed in the preparation, review and finalisation of this document).

FIRE FIGHTING

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FIRE FIGHTING

1.0 INTRODUCTION

Hydrocarbon processing and handling installations are inherently hazardous owing to the highly inflammable nature of petroleum products. Processing plants are becoming more complex due to adoption of new technologies and cost optimisation along with environmental considerations. Though care is taken at design stage itself to avoid possibility of fire occurring in the installation, fire incidents do take place and we need to equip our selves to tackle such situations to minimise loss of production, plant & equipment and precious lives. To achieve the objective, we need to have the right type of equipment and fire fighting agents along with suitable strategy to meet emergency requirements.

2.0 SCOPE

This document provides guidelines for development of detailed procedures for specifications/ inspection and testing of various fire fighting equipment, appliances and materials. It also outlines the basic requirement for fire fighting personnel and need to evolve strategies for meeting emergencies. It covers the petroleum industry as a whole.

3.0 DEFINITIONS

Fire Vehicles -- are mobile vehicles meant for transporting equipment / fire fighting agents / fire fighting crew to the site of fire / other emergency.

Foam -- are an aggregate of air filled bubbles that will float on the surface of a flammable liquid . They are made from aerated solutions of water and a proper proportion of foam concentrate. Foam forms a cohesive floating blanket on the liquid surface that extinguishes the fire by smothering an cooling the fuel. They also prevent re-ignition of combustibles mixtures of vapour and air.

Foam Tender -- is a mobile fire tender consisting of pump, foam proportioning system, foam monitor, water and foam compound tank which can generate foam for blanketing / fire fighting

DCP Tender -- is a mobile fire vehicle consisting of Dry Chemical Powder Vessels, Nitrogen gas cylinders. The Dry Chemical Powder can be used with pressure to knockdown the flame / fire.

Foam Nurser -- is a mobile fire vehicle consisting of pump, foam compound tank which can be used to replenish the foam compound in the foam tenders /Trailer mounted foam tank monitors at emergency site.

Emergency Rescue Tender (ERT) -- is a mobile fire vehicle consisting of emergency rescue equipment which can help to provide immediate assistance for controlling emergencies like fire, oil spillage, accidents etc.

Emergency Rescue Tender (ERT) -- for handling LPG emergencies is a mobile fire vehicle consisting of pump, compressor for handling LPG emergencies (particularly off-site area) including emergency equipment.

Water Tender -- is a mobile fire vehicle consisting of pump, water tank which can be used to deliver water with pressure or foam with auxiliary connection for fire fighting.

4.0 FIRE TENDERS

Specifications for fabricating a fire vehicle commonly used in petroleum industry are given here.

4.1 FOAM TENDER

The Foam Tender including all accessories should be designed and manufactured as per relevant Indian Standards and Tariff Advisory Committee (TAC) 's requirements wherever applicable and should be as per sound engineering practice.

The specifications mentioned hereunder lays down the minimum requirements regarding material, design, construction, workmanship and finish, accessories and acceptance tests of foam tender.

All the equipment and accessories should be fixed on the appliance in a compact and neat manner and should be so placed that each part is easily and readily accessible for use and maintenance. The centre of gravity should be kept as low as possible.

4.1.1 CHASSIS

(i) Foam tender should be fabricated and built on suitable chassis of payload 10 tones or payload 16.8 tones or equivalent to match engine and pump characteristics.

(ii) The Foam Tender should have power steering.

(iii) Drag hook or eye of adequate strength and design should be provided at the front and rear of the chassis.

(iv) All wiring should be properly fixed in position and should be protected against heat, oil and physical damage.Wherever possible wiring should pass through PVC sleeves.

(v) All important electrical circuits should have separate fuses suitably indicated and grouped in a common fuse box located in an easily accessible position. Provision should be made for a minimum four (4) spare fuses in the fuse box.

(vi) Engine : The vehicle engine should be diesel driven preferably with synchromesh 5 forward and 1 reverse speeds gearbox. Engine should be equipped with a complete starting system of 24 V type. An alternator and rectifier capable of delivering a minimum of 50 A at 24 V should be provided.

(vii) Batteries : Ordinary lead acid batteries. Master isolation switch should be provided in dashboard panel.

(viii) Radio suppression of the electrical system, which is sufficient to ensure positive operation of radio equipment without interference, should be provided.

(ix) Braking distance should not be more than 9m at 32 km/hr. when fully loaded.

4.1.2 PUMP

(i) The foam tender should be mounted with one

centrifugal type, single / double stage pump.

(ii) The pump should be capable of discharging minimum 4000 lpm at 8.5 Kg/cm^2. The suction side of the pump should be connected to water tank independently.

(iii) The pump should be capable of discharging not less than 150% of the rated capacity at a head not less than 65% of the rated head. The shut off head of the pump should not exceed 120% of the rated head for the pumps.

(iv) Pump should be suitably mounted on the rear / mid-ship on the chassis and should be accessible and readily removable for repair and maintenance. The pump should have its control panel installed suitably.

(v) The pump should be of rigid construction and should be made of gunmetal/ any suitable light alloy, compatible with fire fighting water and foam compound with stainless steel grade 304 shaft should be suitable for use with saline water.

(vi) The pump impeller shaft should be fitted with anti-friction bearings.

(vii) The pump impeller neck rings and impeller rings should be renewable types and the gland should be self-adjusting type. A drain plug should be provided at the bottom of the casing.

(viii) Primer : The pump should be fitted with an automatic water ring /reciprocating primer. It should be capable of lifting water at-least from a depth of 7.0 m at a rate of not less than 30 cm per second.

(ix) The delivery outlet of the pump should be connected to the monitor and 4/6/8 numbers of screwed 63 mm female instantaneous couplings in accordance with IS:903 – 1975. The monitor and other 63 mm female coupling outlets should be fitted with lever operated ball valves.

(x) Suction lines should be provided with strainers which should be removable easily.

4.1.3 WATER TANK

(i) Water tank of 1800 to 3000 liters capacity should be suitably mounted on the chassis. It should be fabricated out of Mild Steel / stainless steel grade 304/316 sheets; of minimum 5 mm thickness for bottom and 4 mm for sides and top. The gas tungsten arc welding (GTAW) with ER 309 MOL electrode or equivalent and 100% radiography should be followed. Tank made of MS should be epoxy coated. The tank should have adequate MS / SS angle reinforcement.

(ii) It should be provided with a baffles across to prevent surge while the vehicle is accelerating, cornering and braking and should be so designed and mounted as to bring the center of gravity as low as possible in the chassis. The baffles should

be provided with flanged 450 mm dia manholes.

(iii) It should be rectangular / elliptical in shape and the mounting of the tank should be flexible type to prevent the tank distortion due to the chassis flexion. The mounting should permit full contents of the tank to flow into the pump.

(iv) An inspection manhole of not less than 450 mm size should be provided on top, with a hinged or removable cover and should be marked 'WATER".

(v) Suitable eyes should be provided on the shell of the tank to enable it to be lifted off the vehicle for repairs / replacement as necessary.

(vi) A cleaning hole of 250 mm diameter flanged type should be provided at the bottom of the tank. The cleaning hole should be clearly approachable from bottom of chassis and fitted with a 25 mm dia drain pipe with a valve and plug connection and should be taken down to a point well below the chassis without reducing the effective ground clearance.

(vii) The tank should be fitted with overflow pipes of suitable diameter to prevent pressure buildup when connected to the hydrants and the discharge end should be taken below the chassis without reducing the effective ground clearance.

(viii) 150 mm / 200 mm water filling pipe on each side of the vehicle should be provided for water tank filling, fitted with 2/3 numbers of 63 mm instantaneous male couplings incorporating a strainer, NRV (Non Return Valve) and lever operated ball valves near the pump control panels.

(ix) A water level indicator of the graduated glass tube with isolating cock valve (suitably protected) type or other suitable type should be provided close to the control panel. It is suggested to have a illuminated level indication at control panel indicating full, ¾, ½ , ¼ and empty.

(x) The complete tank should be painted externally after fabrication.

(xi) The tank should be connected to the pump through a pipeline fitted with inverted stainless steel strainer and lever operated ball valves.

(xii) All the piping should be subjected to a hydraulic test pressure of 18 Kg/cm^2 for a minimum 30 minutes.

(xiii) All piping / fittings, internals, bolts and nuts of the tanks should be of MS/stainless steel grade 304/316, to minimise galvanic corrosion.

(xiv) Water tank should be tested for leakage period of 24 hours.

(xv) The tank should be provided with a breather valve / vent.

4.1.4 FOAM TANK

(i) Foam Compound tank of 3000 to 4500 liters capacity should be mounted on the chassis. It should be fabricated out of stainless steel grade 304/316 plates of minimum 5 mm thickness for bottom and 4 mm thickness for sides & top. All external surface should be suitably treated to resist atmospheric corrosion and painted.

(ii) The foam tank should be of rigid type rectangular / elliptical in shape with welded construction. The gas tungsten arc welding (GTAW) with ER 309 MOL electrode or equivalent 100% radiography is required.

(iii) The foam tank should be suitably baffled to prevent the surges while the vehicle is accelerating, cornering and braking and should be so designed and mounted as to bring the center of gravity as low as possible in the chassis. The baffles should have flanged man ways of 450 mm dia.

(iv) The tank should be fitted with a sludge trap have a cleaning hole of 250 mm dia and 25 mm drain pipe with a valve and plug incorporated in it. The cleaning hole should be flanged type and easily accessible from the beneath of the vehicle. The bottom of the tank should have a slight slope towards the sludge trap.

(v) The tank should have 2 nos. of filling orifices of not less than 150 mm dia with a removable strainer fitted to it. The filler cap should be clearly marked 'FOAM'.

(vi) The tank should have one line on either side of 75 mm dia with interconnection male coupling and level operated ball valve.

(vii) The tank should have minimum 1 no. of 450 mm dia inspection manhole with hinged or removable covers. The manhole cover should be marked 'FOAM' at the top.

(viii) The tank should be provided with a breather valve to enable automatic venting of the foam compound tank when the foam compound is drawn from it or when the tank in being filled.

(ix) The draw off line should be connected to the foam compound proportioner / indicator and pump and should be 40 mm above the bottom of the foam tank.

(x) The draw-off pipe should be fitted with removable strainer of S.S. material.

(xi) Foam tank should be tested for leakage period of 24 Hrs.

4.1.5 FOAM COMPOUND PROPORTIONER

i) Around the pump proportioner with variable setting selector valve (to induce 3 to 6% of foam compound) should be provided between the foam compound tank and pump. It should be

designed for operation by water under pump pressure.

Balance foam proportioner with manual override is optional.

(ii) The proportioner should be so installed that it should not be liable to mechanical or other damage. The selector valve should have four settings beginning with 'On' or 'Off' position. Each upward setting will result into an equal increase in the foam compound flow rate. The linkages for this purpose should be as simple as possible to avoid distortion due to chassis flexion. It should be very reliable and should not require frequent calibration checks.

(iii) Auxiliary foam pickup tube arrangement from outside should be provided.

4.1.6 POWER TAKE OFF UNIT (PTO)

(i) A power take off unit of suitable gear ratio to match the engine & pump characteristics should be provided.

(ii) A separate lever in the main cabin should engage the PTO.

(iii) Necessary supports for PTO units, propeller shaft couplings, universal joints etc. for power input to and output from PTO unit should be provided.

(iv) The drive assembly components (shaft, couplings etc.) should be dynamically balanced.

4.1.7 WATER / FOAM MONITORS

(i) There should be one roof mounted water-cum-foam aspirating / non aspirating monitor of minimum 2580 lpm capacity and 60 m horizontal water throw at 7.0 Kg/sq.cm.

(ii) The monitor should be capable of traversing through 360^{o} in a horizontal plane and 90^{o} up and 15^{o} down in the vertical plane.

(iii) The monitor and hand-lines should be tested separately and in combination for delivering foam and water throw at rated capacity and range; within the pump capacity.

4.1.8 BODY WORK

(i) Enclosed accommodation should be provided for two men in front compartment including driver. Both the seats should be independent. The driver's seat should be adjustable. The rear compartment of driver's cabin should have one removable seat for full width of cab for crew members. All seats should have foam cushion and should be covered with Rexene. Two doors on either side should be fitted with safety glasses and winding type regulators. The cab floor should be provided with rubber mating. One roof light should be provided in the driver's cabin. Dual type visors and external rear view mirrors should be fitted to the cab.

(ii) The rear removable seat should have box type arrangement to accommodate batteries and other important equipment. Six numbers of hooks should be provided above the rear seat at suitable height for hanging helmets.

(iii) The entire structure of appliance including that of drivers cabin should be a welded structure made from anticorrosion treated M.S. pressed sections and channels structural steel (IS : 2062) with minimum 2 mm or 3 mm thickness aluminum sheet paneling outside. In coastal area, SS 316 material may be considered for structural.
The cross members and support channels should be zinc electroplated, 50 microns for the channels and 20 microns for supports.

(iv) Sufficient number of lockers for storage of all equipment (as listed in 4.1.11 B) should be provided with external access. The height should be not more than 1.67 m so as to be accessible from ground level. The bottom of all the lockers should be of chequered aluminum plate of 4 mm thickness fitted on the base frames to avoid bending of the plates. Sides of the lockers should be of 2 mm aluminum plate with suitable stiffener. The top of lockers should have roof there by providing a working platform for access to tank tops and also the roof mounted monitors.

(v) All the lockers should be fitted with internal lighting with proper guards and suitably located 'ON-OFF' switch. A master switch for isolating the locker lighting circuit should also be fitted in the driver's cab.

(vi) All the lockers should have snap coupling belt fasteners to keep equipment in its place and order.

(vii) All the lockers and other compartments should be suitably provided with heavy-duty doors.

(viii) All the lockers should have self-draining of all wash down water.

(ix) Grab rails and non-slip steps should be provided to give access to the roof of the appliance and for easy and speedy removal and mounted of ladders.

(x) No part of the bodywork should reduce the ground clearance to less than 36 cm or increase the overall width more than 2.42 m. The highest part of the appliance with the ladder and monitor mounted on its should not exceed 3.6 m from ground level. The construction of superstructure should not reduce the angles of approach and departure below 30°.

(xi) Stability : The stability of the appliance when under fully equipped and loaded condition should be such that if the surface on which the appliance stands is tilted to either side, the point at which over turning occurs is beyond an angle of 27°.

4.1.9 CONTROL PANEL

(i) Adequately illuminated pump operating control panels should be provided suitably . The control panel should include the following :

a) Throttle control for the engine.
b) Pump pressure gauge
c) Water tank contents gauges (calibrated)
d) Foam tank contents gauge calibration in liters.
e) Pump suction – water tank isolating valve control.
f) Foam tank isolating valve control.

g) Foam proportioner valve control.
h) Delivery outlets of the pump along with the control levers.
i) The monitor valve control.
j) Engine cooling water temperature.
k) Illuminated water tank level indication.
l) Illuminated foam tank level indication.
m) System schematic etched in brass plate. All levers, switches, valves, inlets / outlets, gauges etc. should bear identification on brass plate duly riveted.
n) Foam pickup tube valve assembly
o) Engine oil pressure gauge
p) Priming pump engagement lever
q) Lighting for control panel illumination
r) Digital flow meter for foam monitor
s) Valve control for hose reel

(ii) The dashboard panel in the drivers cabin should have :

a) Engine oil temperature gauge.
b) Engine oil pressure gauge.
c) Ammeter battery charging rate.
d) Air pressure gauge for the braking systems.
e) Fuel tank contents gauge calibrated in liters.
f) Odometer calibrated in KM.
g) Speedometer calibrated in KM/hr.
h) Siren switch.
i) Ignition switch.
j) Engine cooling water temperature gauge.
k) Master switch for batteries.

In addition to the above, other items may also be provided that may be considered essential.

4.1.10 PAINTING & MARKING

(i) The entire appliance should be painted in ‘Fire Red’ paint of shade No.536 of IS: 5-1961 (yellow colour optional) and thickness of 0.12 to 0.2mm using double coat spray painting on the outside.

(ii) Also, on either side of the appliance, monogram should be painted. The lettering of ‘FOAM TENDER’ should be written in golden yellow colour at suitable places.

(iii) The driver’s compartment should be laminated and the inside of lockers should be painted cream. Lockers should be finished in shadow board painting to show the position of each piece of equipment.

(iv) The chassis and wheel arches should be painted black.

(v) Water piping should be painted red, foam compound piping yellow and water / foam solution in red & yellow stripes.

(vi) Two coats of anticorrosion paint and one coat of zinc phosphate primer should be applied before painting.

(vii) The appliance should be clearly and permanently marked with the following, preferably on a metal plate attached in the driver’s cabin and also near

pump operating control panels;

a) Manufacturer's name or trade mark;
b) Year of manufacturer
c) Capacity of pump in lpm water tank in liters and foam tank in liters
d) Engine and chassis number
e) Pump number

4.1.11 ACCESSORIES

A. Foam Tender should be provided with the following accessories in addition to those normally fitted to the chassis. All the accessories should be suitably fixed in position or should be kept in position or should be kept in lockers or other suitable place on the tender.

a) Electrically operated siren – to be mounted externally.
b) Fog lamps powered by the battery of the appliance should be low mounted in front of the appliance
c) Reversing lights four numbers – suitably situated to assist reversing.
d) Blinker type traffic indicators.
e) Twin amber blinker lights – cabin roof mounted.
f) Search light with 50 meters length of cable with tripod etc., complete
g) An adjustable spot light
h) Portable inspection lamp with brackets to be clamped to the battery
i) All tools required for normal routine maintenance of the appliance, which are not included with the kit of the chassis
j) Spark arrestor fitted to the exhaust of the engine (CCE approved)
k) A trickle charger 250 AC supply for self charging of battery being charged. It should be fitted in the drivers cabin.
l) Wind screen wipers (Electrically operated of approved design) if not provided with the chassis.
m) Hydraulic jack – 25 tones capacity
n) Oil feeder.
o) Grease gun.
p) First Aid Box.
q) Public address system : Battery operated with a control panel in driver's cabin should be provided. One loud speaker should be mounted on driver's cabin roof and should be capable of rotation in all directions. The range should be 1 km in still air and 500 m in noisy areas.
r) Suction hoses and fittings

B. Equipment for Tender

1. Fire hoses
2. Fire extinguishers
3. Nozzles & branches
4. Foam making branch-line
5. Mechanical foam generator
6. Adaptor
7. Dividing breaching made out of light alloy (IS : 5131 – 1969)
8. Collecting breaching made out of light alloy (IS : 905 – 1968)
9. Lug spanner (IS : 903 – 1971)
10. Fireman's Axe (IS:5505 – 1999)
11. Nylon rope, 50 mm circumference, 30 m long (IS : 9048 – 1960)

12. Ladders : 7.5 m long aluminum two Piece extension ladder (IS : 4571)

13. Breather Apparatus

14. Fire Proximity Suit

4.1.12 ACCEPTANCE TESTS

Following tests should be carried out before commissioning the vehicle :

a) Road tests to check chassis, manufacturer's rating for acceleration, maximum speed, braking efficiency and turning circle with appliance fully loaded.

b) Stability test.

c) When the vehicle is brought to a stop in 9 m when travelling at 32 KM/hr. fully loaded and manned on pavement without any adverse effect on mounted equipment.

d) Pump test to check pump manufacturer's rated output at varying pump pressure for a continuous period of 4 hours. During this test, the temperature of engine should not exceed the rated temperature and that of lubricating oil 79ºC.

e) Foam Monitor and hand-lines Test : Monitor performance for rated flow and throw should be tested.

4.1.13 INSTRUCTION BOOK(S)

(i) A set of illustrated books along with as built drawing, flow diagram, general assembly & cross sectional drawing for pump, drawings of PTO, line diagram for electrical circuits for foam tender for guidance, including operating and normal maintenance procedures for the appliance, should be kept.

The test certificates and original manuals of all the bought out items should be kept.

(ii) The books should include an item-wise and illustrated spare parts lists giving reference number to all wearing parts with a view to ensure that adequate number of such spare parts are made easily available, when necessary. It should also include as built line diagrams showing all piping work connecting, water tank, foam tank, foam proportioning system and pump. All inspection and testing records including calibration and hydro-testing certificates should be included in manual.

4.1.14 SPARES

A complete set of recommended spare parts for foam monitors, foam proportioner, pump, battery charger etc. should be kept with tender.

4.1.15 STAGE INSEPCTIONS

Inspections should be carried out for various materials / quality of work at various stages of procurement / fabrication / body building of the Foam Tender.

4.1.16 Vehicle should confirm to Motor Vehicle Act 1988 and Motor Vehicles Rules thereunder.

4.2 FOAM NURSER

The Foam Nurser including all accessories should be designed and manufactured as per relevant Indian

Standards and TAC requirements wherever applicable and should be as per sound engineering practice.

The specifications given here are guidelines for material, design, construction and accessories etc. for Foam Nurser.

All the equipment and accessories should be fixed on the appliance in a compact and neat manner and should be so placed that each part is easily and readily accessible for use and maintenance. The centre of gravity should be kept as low as possible.

4.2.1 CHASSIS

(i) The foam nurser should be fabricated on a suitable chassis of pay load capacity 10 tonnes or 16.8 tonnes or 19.0 tonnes.

(iii) The spare wheel assembly (supplied along with chassis) should be fitted at a suitable place on the appliance.

(i) Drag hook or eye of adequate strength and design should be provided at the rear of the chassis.

(ii) Welding and drilling on frame work of chassis is not desirable.

(iii) The foam Nurser should have a power steering.

(iv) All wiring should be properly fixed in position and should be protected against heat, oil and physical damage. Whenever possible wiring should pass through PVC sleeves.

(v) All important electrical circuits should have separate fuses suitably indicated and grouped in a common fuse box located in an easily accessible position. Provision should be made for a minimum (4) spare fuses in the fuse box.

(vi) Engine : The vehicle engine should be diesel driven with synchromesh 5 forward and 1 reverse speeds gear box. Engine should be equipped with a complete starting system of 24 V type. An alternator and rectifier capable of delivering a minimum of 50 A at 24 V should be provided.

(vii) Batteries : Ordinary lead acid batteries. Master isolation switch should be provided in dashboard panel.

(viii) Radio suppression of the electrical system, which is sufficient to ensure positive operation of radio equipment without interference, should be provided.

(ix) Braking distance should not be more than 9m at 32 Km/Hr. when fully loaded.

4.2.2 FOAM TANK

(a) The net capacity of the foam tank should be 7000 to 12000 liters. The tank should have 2% expansion space over and above foam compound capacity.

(b) The materials of construction of foam tank and fittings should be SS-304 / SS- 316.

(c) The foam tank of rectangular / elliptical shape and should be made of 5 mm. (minimum) for bottom and 4 mm minimum thick plates for sides and top. The tank should be welded in construction and should have adequate SS angle reinforcement. Suitable baffles should be provided inside the tank, made out of 5mm. SS-304 / SS- 316 plates to prevent surging, when vehicle is in motion. The baffle plates should be placed at every 900mm (max.) interval. Hooks should be provided on roof of the tank for lifting purpose. Tank should have following provisions and connections:

i) Suitable sized breather for removal of air during filling and pumping out.

ii) Sludge trap (dia. 250 mm.) with ball valve & piping. Tank bottom to be sloped towards sludge trap.

iii) Anti-vortex device at nozzle for pump suction.

iv) Foam level indicator (non-sticking type gauge glass) duly calibrated.

v) Drain valve (dia. 50 mm.) with 63 mm. instantaneous male coupling terminating at side of nurser.

vi) 1 No. 150 mm. dia filling hole on top to be provided with threaded cap and SS strainer. The cap should have an etched SS name plate with marking “FOAM” (letter size 100 mm.)

vii) Minimum 2 Nos. 450 mm. dia. manhole with hinged and bolted cover with suitable gasket. The manhole should have an etched SS name plate with marking “FOAM” (letter size 100 mm.)

viii) A dip hatch with calibrated dip stick. Calibration chart should be provided by vendor.

ix) Suitable ladder for climbing on the top of tank.

x) 50mm overflow pipe

(d) The welding should be Gas Tungston Arc Welding (GTAW) with ER 309 MOL electrode or equivalent.

4.2.3 FOAM PUMP

(i) The pump to handle foam compound should be rotary gear type. The pump should be driven by chassis engine through PTO and should meet following specifications:

a) Capacity : Minimum 400 lpm at 7 kg./CM^2(g) discharge pressure.

b) Priming: Self priming under gravity feed from tank and capable to lift foam from barrel kept on ground.

c) Materials: Casing, shaft and other parts coming in contact with the foam compound should be of SS-304 except gears manufactured from SS AISI-410.

d) Type of Gears: Double helical, hardened and profile ground.

e) Bearings: GM and teflon bush bearing (replaceable type).

f) Shaft Seal: Mechanical seal.

g) Relief Valve: External to pump with body and trim of SS-304. Set pressure to be fixed by vendor. PSV discharge to go to tank.

(ii) The pump must have a bypass line for manual re-circulation of foam to foam tank.

(iii) The pump should be used to transfer foam from tank to other Fire Tenders or to transfer foam from 200 litres. Barrel or any other Fire Tender to foam tank on chassis.

(iv) The pump should take suction from main tank by gravity or through any one of the inlet connections provided at side of tender for picking up foam from barrels or from any other Fire Tender.

(v) The pump delivery should be routed to 2 Nos. (one on each side of vehicle), 38 / 63 mm. Instantaneous female coupling.

4.2.5 POWER TAKE-OFF (PTO) UNIT

(i) The Power Take Off (PTO) Unit for driving the pump should be of suitable type to match the pump characteristics.

(ii) PTO Unit should be engaged by a separate lever in the main cabin.

(iii) Necessary supports for PTO Units, propeller shafts, coupling, universal joints etc. for power input to and output from PTO units should have to be provided.

(iv) The drive assembly components (shafts, coupling etc.) should be dynamically balanced.

4.2.6 PIPING

(i) All piping should be sized so as to have minimum pressure drop and achieve the required pressure and flow.

(ii) All pipe fittings and valves should be MS / SS - 304 / SS - 316.

(iii) All piping should be seamless and designed for 10% over the maximum pressures encountered in the pipe.

(iv) The piping should be flanged for ease of maintenance. However, flange joints kept minimum.

(v) Valves of less than 1.5” NB size should be forged and valve more than 2” NB size can be of cast construction.

(vi) All lines should be hydraulically tested at 1.5 times the design pressure. However, in no case should the lines be hydraulically tested below 18 kg/cm^2(g).

(vii) All lines should be suitably supported so as to provide rigidity and avoid vibrations.

(viii) All lines less than 1.5” NB size can be socket

welded to matching 300 lbs. rating fittings. All lines above 2” NB size should be butt welded with full penetration welds.

(ix) All gaskets in foam lines should be spiral wound with SS-304 and asbestos filler.

All bolting should be of SS-304.

(x) An SS Y-type strainer should be provided before the foam pump. The strainer should be so located so as to permit easy removal of strainer element.

(xi) The draw off pipe should be provided in such a manner and in such a position that sludge should not pass into foam piping.

4.2.7 CONTROL PANEL

(i) Adequately illuminated pump operating control panels should be provided near the pump of the appliance. The control panel should include the following :

a) Throttle control for the engine.
b) Pump pressure guage.
c) Foam tank contents gauge calibration in litres.
d) Pump suction – foam tank isolating valve control.
e) Delivery outlets of the pump along with the control levers.
f) Engine cooling water temperature.
g) Illuminated foam tank level indication.
h) System schematic etched in brass plate. All levers, switches, valves, inlets / outlets, gauges etc. should bear identification on brass plate duly riveted.

(ii) The dashboard panel in the drivers cabin should have :

a) Engine oil temperature gauge.
b) Engine oil pressure gauge.
c) Ammeter battery charging rate.
d) Air pressure gauge for the braking systems.
e) Fuel tank contents gauge calibrated in litres.
f) Odometer calibrated in KM.
g) Speedometer calibrated in KM/hr.
h) Siren switch.
i) Ignition switch.
j) Engine cooling water temperature gauge.
k) Master switch for batteries.

In addition to the above, other items may also be provided that may be essential.

4.2.8 BODY WORK

(i) Enclosed accommodation should be provided for two men in front compartment including driver. Both the seats should be independent. The driver’s seat should be adjustable. The rear compartment of driver’s cabin should have one removable seat for full width of cab for crew members. All sears should have foam cushion and should be covered with rexine. Two doors on either side should be fitted with

safety glasses and winding type regulators. The cab floor should be provided with rubber mating. One roof light should be provided in the driver's cabin. Dual type visors and outside fitting rear view mirrors should be fitted to the cab.

(ii) The rear removable seat should have box type arrangement to accommodate batteries and other important equipment, six numbers of hooks should be provided above the rear seat at suitable height for hanging helmets.

(iii) The entire structure of appliance including that of drivers cabin should be a welded structure made from anticorrosion treated M.S. pressured sections and channels structural steel (IS 2062) with minimum 2 mm or 3 mm thickness aluminum sheet panelling outside. In coastal area, SS 304 material may be considered for panelling. The cross members and support should be zinc electroplated, 50 microns for the channels and 20 microns for supports.

(iv) Sufficient number of lockers for storage of all equipment should be provided with external access. The height should be not more than 1.67 m so as to be accessible from ground level. The bottom of all the lockers should be of chequered aluminium plate of 4 mm thickness fitted on the base frames to avoid bending of the plates. Sides of the lockers should be of 2 mm aluminium plate with suitable stiffener. The top of lockers should have roof, there by providing a working platform for access to tank tops and also the roof mounted monitors.

(v) All the lockers should be fitted with internal lighting with proper guards and suitably located 'ON-OFF' switch. A master switch for isolating the locker lighting circuit should also be fitted in the Driver's cab.

(vi) All the lockers should have snap coupling belt fasteners to keep equipment in its place and order.

(vii) All the lockers and other compartments should be suitably provided with heavy duty doors.

(viii) All the lockers should have self draining of all wash down water.

(ix) Grab rails and non-slip steps should be provided to give access to the roof of the appliance and for easy and speedy removal and mounted of ladders.

(x) No part of the body work should reduce the ground clearance to less than 36 cm or increase the overall width to more than 2.42 m. The highest part of the appliance with the ladder and monitor mounted on its should not exceed 3.6 m from ground level. The construction of superstructure should not reduce the angles of approach and departure below 30°.

(xi) Stability : The stability of the appliance should be such that when under fully equipped and loaded condition if the surface on which the appliance stands is tilted to either side, the point at which over turning occurs is beyond angle of 27°.

4.2.9 PAINTING & MARKING

(i) The entire appliance should be painted in 'Fire Red' paint of shade No.536 of IS: 5-1961 or in "Golden Yellow" paint of shade no. 356 of IS-: 5 1961 and thickness of 0.12 to 0.2 mm using double coat spray painting on the outside.

(ii) Also, on either side of the appliance, monogram should be painted. The lettering of 'FOAM NURSER' should be written in golden yellow colour or black colour at suitable places.

(iii) The driver's compartment should be laminated and the inside of lockers should be painted cream. Lockers should be finished in shadow board painting to show the position of each piece of equipment.

(iv) The chassis and wheel arches should be painted black.

(v) Two coats of anticorrosion paint and one coat of zinc phosphate primer should be applied before painting.

(vi) The appliance should be clearly and permanently marked with the following, preferably on a metal plate attached in the driver's cabin and also near pump operating control panels;

a)Manufacturer's name or trade mark
b)Year of manufacturer
c)Capacity of pump in Ipm and foam tank in liters
d)Engine and chassis number
e)Pump number

4.2.10 ACCEPTANCE TESTS

Following tests should be carried out before commissioning the vehicle :

a) Road tests to check chassis, manufacturer's rating for acceleration, maximum speed, braking efficiency and turning circle with appliance fully loaded.
b) Stability test.
c) When the vehicle is brought to a stop in 9 m when travelling at 32 KM/hr. fully loaded and manned on pavement without any adverse effect on mounted equipment.
d) Pump test to check pump manufacturer's rated output at varying pump pressure for a continuous period of 4 hours. During this test, the temperature of engine should not exceed the rated temperature and that of lubricating oil 79°C.

4.2.11 STAGE INSPECTIONS

Inspections should be carried out for various materials / quality of work at various stages of procurement / fabrication / body building of the Foam Nurser.

4.2.12 INSTRUCTION BOOK(S)

(i) A set of illustrated books along with as built drawing, Flow diagram, General assembly & cross sectional drawing for pump, drawings of PTO, line diagram for electrical circuits for Foam Nurser for guidance, including both operating and normal maintenance procedures for the appliance, should be kept. The test certificates and original manuals of all bought out items should also be kept in original.

(ii) The books should include an item-wise and illustrated spare parts lists giving reference number to all wearing parts with a view to ensure that adequate number of such spare parts are made easily available, when necessary. It should also include as built line diagrams showing all piping work connecting, foam tank and pump. All inspection and testing records including calibration and hydro-testing certificates should be included in manual.

4.2.13 ACCESSORIES

Foam Nurser should be provided with the following accessories in addition to those normally fitted to the chassis. All the accessories should be suitably fixed in position or should be kept in position or should be kept in lockers or other suitable place on the nurser.

a) Electrically operated siren to be mounted externally.
b) Fog lamps powered by the battery of the appliance should be low mounted in front of the appliance
c) Reversing lights four numbers – suitably situated to assist reversing.
d) Blinker type traffic indicators
e) Twin amber blinker lights– cabin roof mounted.
f) Search light with 50 meters length of cable with tripod etc., complete
g) An adjustable spot light
h) Portable inspection lamp with brackets to be clamped to the battery
i) All tools required for normal routine maintenance of the appliance, which are not included with the kit of the chassis
j) Spark arrestor fitted to the exhaust of the engine
k) A trickle charger 250 AC supply for self charging of battery being charged. It should be fitted in the drivers cabin.
l) Wind screen wipers (Electrically operated of approved design) if not provided with the chassis.
m) Hydraulic jack – 25 tones capacity
n) Oil feeder.
o) Grease gun.
p) First Aid Box.
q) Public address system : Battery operated with a control panel in driver's cabin should be provided. One loud speaker should be mounted on driver's cabin roof and should be capable of rotation in all directions. The range should be 1 km in still air and 500 m in noisy areas.
r) Suction hoses.

4.3 FIRE WATER TENDER

The specification covers the minimum requirement regarding design, material, fabrication, workmanship & finish accessories and acceptance tests of fire water tender of 6000 liter capacity to be used as a major fire fighting appliance.

4.3.1 CHASSIS

The water tank should be fabricated and built on a suitable chassis of pay load capacity 10 tonnes or 16.8 tonnes.

4.3.2 PUMP

(i) The Tender should be mounted with one centrifugal type, single / double stage pump.

(ii) The pump should be capable of discharging minimum 4000 lpm at 8.5 Kg/Cm^2. The suction side of the pump should be connected to water tank independently.

(iii) The pump should be capable of discharging not less than 150% of the rated capacity at a head not less than 65% of the rated head. The shut off head of the pump should not exceed 120% of the rated head for the pumps.

(iv) Pump should be suitably mounted on the rear / mid-ship mounted on the chassis and should be accessible and readily removable for repair and maintenance. The pump should have its control panel installed suitably.

(v) The pump should be of rigid constructions and should be made of Gunmetal/ any suitable light alloy, compatible with fire fighting water and foam compound with Stainless Steel Grade 304 shaft should be suitable for use with saline water.

(vi) The pump impeller shaft should be fitted with anti-friction bearings.

(vii) The pump impeller neck rings and impeller rings should be renewable types and the gland should be self-adjusting type. A drain plug should be provided at the bottom of the casing.

(viii) Primer : Pump should be fitted with an automatic water ring /reciprocating primer. It should be capable of lifting water at-least through 7.0 m at a rate of not less than 30 cm per second.

(ix) The delivery outlet of the pump should be connected to the monitor and 4/6/8 numbers of screwed 63 mm female instantaneous couplings should be in accordance with IS:903 – 1975. The monitor and other 63 mm female coupling outlets should be fitted with lever operated ball valves.

(x) Suction lines should be provided with strainers which should be removable easily.

4.3.3 WATER TANK

I. Water tank of minimum 6000 liters capacity should be suitably mounted on the chassis. It should be fabricated out of MS/Grade 304/316 Stainless Steel sheets; of minimum 5 mm thickness for bottom and 4 mm for sides and top. The Gas Tungsten Arc Welding (GTAW) with ER 309 MOL electrode or equivalent and 100% radiography should be followed. Tank made of MS should be epoxy coated. The tank should have adequate MS / SS angle reinforcement.

II. It should be provided with a baffles across to prevent surge while the vehicle is accelerating, cornering and braking and should be so designed and mounted as to bring the center of gravity as low as possible in the chassis. The baffles should be provided with flanged 450 mm dia manholes.

III. It should be rectangular / elliptical in shape and the mounting of the tank should be flexible type to prevent the tank distortion due to the chassis flexion. The mounting should permit full contents of the tank to flow into the pump.

IV. An Inspection manhole of not less than 450 mm size should be provided on top, with a hinged or removable cover and should be marked ‘WATER”.

V. Suitable eyes should be provided on the shell of the tank to enable it to be lifted off the vehicle for repairs / replacement as necessary.

VI. A cleaning hole of 250 mm diameter flanged type should be provided at the bottom of the tank. The cleaning hole should be clearly approachable from bottom of chassis and fitted with a 25 mm dia drain pipe with a valve and plug connection and should be taken down to a point well below the chassis without reducing the effective ground clearance.

VII. The tank should be fitted with overflow pipes of suitable diameter to prevent pressure buildup when connected to the hydrants and the discharge end should be taken below the chassis without reducing the effective ground clearance.

VIII. 150 mm / 200 mm water filling pipe on each side of the vehicle should be provided for water tank filling, fitted with 2/3 numbers of 63 mm instantaneous male couplings incorporating a strainer, NRV (Non Return Valve) and lever operated ball valves near the pump control panels.

IX. A water level indicator of the graduated glass tube with isolating cock valve (suitably protected) type or other suitable type should be provided close to the control panel. It is suggested to have a illuminated level indication at control panel indicating full, ¾, ½ , ¼ and empty.

X. The complete tank should be painted externally after fabrication.

XI. The tank should be connected to the pump through a pipeline fitted with inverted stainless steel strainer and lever operated ball valves.

XII. All the piping should be subjected to a hydraulic test pressure of 18 Kg/cm^2 for a minimum 30 minutes.

XIII. All the fittings, internals, bolts and nuts of the tanks should be of MS/stainless steel grade 304/316, to minimise galvanic corrosion.

XIV. Water tank should be tested for leakage period of 24 hours.

XV The tank should be connected with the pump and hose reel and valve(s) should be provided in such a way that any of the following operations are possible.

(a) Hydrant to tank

(b) Hydrant to hose reel

(c) Tank to pump to hose reel

(d) Hydrant to pump to hose reel

4.3.4 WATER MONITORS

a) There should be one roof mounted water monitor of minimum 2580 lpm capacity and minimum 60 m horizontal throw at 7.0 Kg/sq.cm.

b) The monitor should be capable of traversing through 360° in a horizontal plane and 90° up and 15° down in the vertical plane.

c) The monitor and hand-lines should be tested separately and in combination for delivering water throw at rated capacity

and range; within the pump capacity.

4.3.5 HOSE REEL

One hose reel (see IS:884) should be provided at the rear of the appliance with 60 m lengths of 20 mm bore. Hose connected by screw 'C' type quick release couplings and terminating with a control branch and 5 MM nozzle. The reel should be fitted with brake and locking device. The hose reel shall withstand 14 kg/cm2 pressure.

4.3.6 BODY WORK

I. Enclosed accommodation should be provided for two men in front compartment including driver. Both the seats should be independent. The driver's seat should be adjustable. The rear compartment of driver's cabin should have one removable seat for full width of cab for crew members. All seats should have foam cushion and should be covered with Rexene. Two doors on either side should be fitted with safety glasses and winding type regulators. The cab floor should be provided with rubber mating. One roof light should be provided in the driver's cabin. Dual type visors and outside fitting rear view mirrors should be fitted to the cab.

II. The rear removable seat should have box type arrangement to accommodate batteries and other important equipment. Six numbers of hooks should be provided above the rear seat at suitable height for hanging helmets.

III. The entire structure of appliance including that of drivers cabin should be a welded structure made from anticorrosion treated M.S. pressured sections and channels structural steel (IS : 2062) with minimum 2 mm or 3 mm thickness aluminum sheet paneling outside. In coastal area, SS 316 material may be considered for structural.

IV. The cross members and support channels should be zinc electroplated, 50 microns for the channels and 20 microns for supports.

V. Sufficient number of lockers for storage of all equipment (as listed below) should be provided with external access. The height should be not more than 1.67 m so as to be accessible from ground level. The bottom of all the lockers should be of chequered aluminum plate of 4 mm thickness fitted on the base frames to avoid bending of the plates. Sides of the lockers should be of 2 mm aluminum plate with suitable stiffener. The top of lockers should have roof there by providing a working platform for access to tank tops and also the roof mounted monitors.

VI. All the lockers should be fitted with internal lighting with proper guards and suitably located 'ON-OFF' switch. A master switch for isolating the locker lighting circuit should also be fitted in the driver's cab.

VII. All the lockers should have snap coupling belt fasteners to keep equipment in its place and order.

VIII. All the lockers and other compartments should be suitably provided with heavy-duty doors.

IX. All the lockers should have self-draining of all wash down water.

X. Grab rails and non-slip steps should be provided to give access to the roof of the appliance and for easy and speedy removal and mounted of ladders.

XI. No part of the bodywork should reduce the ground clearance to less than 36 cm or increase the overall width more than 2.42 m. The highest part of the appliance with the ladder and monitor mounted on its should not exceed 3.6 m from ground level. The construction of superstructure should not reduce the angles of approach and departure below 30°.

XII. Stability : The stability of the appliance should be such that when under fully equipped and loaded condition if the surface on which the appliance stands is tilted to either side, the point at which over turning occurs is beyond a angle of 27°.

4.3.7 CONTROL PANEL

(A) Adequately illuminated pump operating control panels should be provided on rear side of the appliance. The control panel should include the following :

I. Throttle control for the engine.
II. Pump pressure gauge calibrated in liters.
III. Water tank contents gauges.
IV. Pump suction – water tank isolating valve control.
V. Delivery outlets of the pump along with the control levers.
VI. The monitor valve control.
VII. Engine cooling water temperature.
VIII. Illuminated water tank level indication.
IX. System schematic etched in brass plate. All levers, switches, valves, inlets / outlets, gauges etc. should bear identification on brass plate duly riveted.
X. Hose reel valve control

(B) The dashboard panel in the drivers cabin should have :

- Engine oil temperature gauge.
- Engine oil pressure gauge.
- Ammeter battery charging rate.
- Air pressure gauge for the braking systems.
- Fuel tank contents gauge calibrated in liters.
- Odometer calibrated in KM.
- Speedometer calibrated in KM/hr.
- Siren switch.
- Ignition switch.
- Engine cooling water temperature gauge.
- Master switch for batteries.

In addition to the above, other items may also be provided that may be essential.

4.3.8 PAINTING & MARKING

I. The entire appliance should be painted in ‘Fire Red’ paint of shade No.536 of IS: 5-1961 or in “Golden yellow” paint of shade no. 356 of IS:5 – 1961 and thickness of 0.12 to 0.2mm using double coat spray painting on the outside.

II. Also, on either side of the appliance, monogram should be painted. The lettering of ‘WATER TENDER’ should be written in golden yellow colour for Fire Red body and black colour for Golden yellow body at suitable places.

III. The driver's compartment should be laminated and the inside of lockers should be painted cream. Lockers should be finished in shadow board painting to show the position of each piece of equipment.

IV. The chassis and wheel arches should be painted black.

V. Piping should be painted red.

VI. Two coats of anticorrosion paint and one coat of zinc phosphate primer should be applied before painting.

VII. The appliance should be clearly and permanently marked with the following, preferably on a metal plate attached in the driver's cabin and also near pump operating control panels;

a) Manufacturer's name or trade mark;
b) Year of manufacturer;
c) Capacity of pump in lpm water tank in liters and foam tank in liters;
d) Engine and chassis number;
e) Pump number;

4.3.9 ACCESSORIES

Water Tender should be provided with the following accessories in addition to those normally fitted to the chassis. All the accessories should be suitably fixed in position or should be kept in position or should be kept in lockers or other suitable place on the tender.

a) Electrically operated siren to be mounted externally.
b) Fog lamps powered by the battery of the appliance should be low mounted in front of the appliance
c) Reversing lights suitably situated to assist reversing.
d) Blinker type traffic indicators
e) Twin amber blinker lights– cabin roof mounted.
f) Search light with 50 meters length of cable with tripod etc., complete
g) An adjustable spot light
h) Portable inspection lamp with brackets to be clamped to the battery
i) All tools required for normal routine maintenance of the appliance, which are not included with the kit of the chassis
j) Spark arrestor fitted to the exhaust of the engine
k) A trickle charger 250 AC supply for self charging of battery being charged. It should be fitted in the drivers cabin.
l) Wind screen wipers (Electrically operated of approved design) if not provided with the chassis.
m) Hydraulic jack – 25 tones capacity
n) Oil feeder.
o) Grease gun.
p) First Aid Box.
q) Public address system : Battery operated with a control panel in driver's cabin should be provided. One loud speaker should be mounted on driver's cabin roof and should be capable of rotation in all directions. The range should be 1 km in still air and 500 m in noisy areas.
r) Suction hoses with fittings

Equipment for Tender

1. Fire Hoses
2. Fire Extinguishers
3. Nozzles & branches
4. Foam Making branch-line
5. Mechanical Foam Generator
6. Adaptor
7. Dividing breaching made out of light alloy (IS : 5131 – 1969)
8. Collecting breaching made out of light alloy (IS : 905 – 1968)
9. Lug spanner (IS : 903 – 1971)
10. Fireman's Axe (IS:5505 – 1999)
11. Nylon rope, 50 mm circumference, 30 m long

(IS : 9048 – 1960)

12.Ladders : 7.5 m long aluminum two Piece extension ladder (IS : 4571)

11. Breather apparatus set
12. Fire Proximity Suit

4.3.10 ACCEPTANCE TESTS

Following tests should be carried out before commissioning the vehicle :

a) Road tests to check chassis, manufacturer's rating for acceleration, maximum speed, braking efficiency and turning circle with appliance fully loaded.
b) Stability test.
c) When the vehicle is brought to a stop in 9 m when travelling at 32 KM/hr. fully loaded and manned on pavement without any adverse effect on mounted equipment.
d) Pump test to check pump manufacturer's rated output at varying pump pressure for a continuous period of 4 hours. During this test, the temperature of engine should not exceed the rated temperature and that of lubricating oil 79ºC.

4.3.11 INSTRUCTION BOOK(S)

I. A set of illustrated books along with as built drawing, Flow diagram, General assembly & cross sectional drawing for pump, drawings of PTO, line diagram for electrical circuits for Water Tender for guidance, including both operating and normal maintenance procedures for the appliance, should be kept. The test certificates and original manuals of all the bought out should be kept.

II. The books should include an item-wise and illustrated spare parts lists giving reference number to all wearing parts with a view to ensure that adequate number of such spare parts are made easily available, when necessary. It should also include as built line diagrams showing all piping work connecting, water tank, hand lines, monitors, hose reels and pump. All inspection and testing records including calibration and hydro-testing certificates should be included in manual.

4.3.12 SPARES

A complete set of recommended spare parts for monitors, pump, battery charger etc. should be kept with tender.

4.3.13 Inspection and Testing

Inspections should be carried out for various materials / quality of work at various stages of procurement / fabrication / body building of the Tender.

4.4 EMERGENCY RESCUE TENDER

The Emergency Rescue Tender (ERT) including all accessories should be designed and manufactured as per relevant Indian Standards and TAC's requirements wherever applicable and should be as per sound engineering practice.

The specifications mentioned hereunder lays down the requirements regarding material, design, construction, workmanship and finish, accessories and acceptance tests emergency rescue vehicle .

All the equipment and accessories should be fixed on the appliance in a compact and neat manner and should be so placed that each part is easily and readily accessible for use and maintenance. The centre of gravity should be kept as low as possible.

This specification covers the general requirements regarding materials, performance and acceptance tests for Emergency Rescue Tender to be used for Rescue Operations including handling LPG Emergencies. The scope of supply should be inclusive of, but not limited to the following:

- Diesel generator set of 5 KVA fitted with CCE approved spark arrestor & Flood lighting arrangement.
- A battery operated amplifier system.
- An extension ladder.
- Pneumatic lifting equipment.
- Leak sealing pads
- Leak control kits.
- Low temperature protective suit
- Fire entry suit
- Fire proximity suit
- Hydraulic spreader and cutter
- Portable gas detectors
- LPG transfer equipment
- Traffic control equipment
- other accessories.

4.4.1 CHASSIS

I. The Tender should be fabricated and built on suitable chassis of Payload 10 tones or Payload 16.8 tones or equivalent .

II. The tender should have power steering.

III. Drag hook or eye of adequate strength and design should be provided at the rear of the chassis.

IV. All wiring should be properly fixed in position and should be protected against heat, oil and physical damage. Wherever possible wiring should pass through PVC sleeves.

V. All important electrical circuits should have separate fuses suitably indicated and grouped in a common fuse box located in an easily accessible position. Provision should be made for a minimum (4) spare fuses in the fuse box.

VI. Engine : The vehicle engine should be diesel driven preferably with synchromesh 5 forward and 1 reverse speeds gearbox. Engine should be equipped with a complete starting system of 24 V type. An alternator and rectifier capable of delivering a minimum of 50 A at 24 V should be provided.

VII. Batteries : Ordinary lead acid batteries. Master isolation switch should be provided in dashboard panel.

VIII. Radio suppression of the electrical system, which is sufficient to ensure positive operation of radio equipment without interference, should be provided.

IX. Braking distance should not be more than 9m at 32 km/hr. when fully loaded.

EMERGENCY LIGHTING SYSTEM

(i) Emergency lighting system should be consisting of minimum 5 KVA ISI marked single phase diesel generator set. This should have push start and should provide power for 4 Nos. of flame proof Halogen floodlight of 500 W each & 02 Nos. of flame proof 250 Watt light with stand and 50 m . cable reel drum.

(ii) There should be a control panel accommodating switches for the lights as well as to start/stop the generator. Also 3 pin and 2 pin sockets to be provided.

(iii) All lights should be mounted on extendible mast and should be minimum 3 meter height.

4.4.2 BODY WORK

(i) Enclosed accommodation should be provided for two men in front compartment including driver. Both the seats should be independent. The driver's seat should be adjustable. The rear compartment of driver's cabin should have one removable seat for full width of cab for crew members. All seats should have foam cushion and should be covered with Rexene. Two doors on either side should be fitted with safety glasses and winding type regulators. The cab floor should be provided with rubber mating. One roof light should be provided in the driver's cabin. Dual type visors and outside fitting rear view mirrors should be fitted to the cab.

(ii) The rear removable seat should have box type arrangement to accommodate batteries and other important equipment. Six numbers of hooks should be provided above the rear seat at suitable height for hanging helmets.

(iii) The entire structure of appliance including that of drivers cabin should be a welded structure made from anticorrosion treated M.S. pressured sections and channels structural steel (IS : 2062) with minimum 2 mm or 3 mm thickness aluminum sheet paneling outside. In coastal area, SS 316 material may be considered for structural.

The cross members and support channels should be zinc electroplated, 50 microns for the channels and 20 microns for supports.

(iv) Sufficient number of lockers for storage of all equipment (as listed below) should be provided with external access. The height should be not more than 1.67 m so as to be accessible from ground level. The bottom of all the lockers should be of chequered aluminum plate of 4 mm thickness fitted on the base frames to avoid bending of the plates. Sides of the lockers should be of 2 mm aluminum plate with suitable stiffener. The top of lockers should have roof there by providing a working platform for access to tank tops and also the roof mounted monitors.

(v) All the lockers should be fitted with internal lighting with proper guards and suitably located 'ON-OFF' switch. A master switch for isolating the locker lighting circuit should also be fitted in the driver's cab.

(vi) All the lockers should have snap coupling belt fasteners to keep equipment in its place and order.

(vii) All the lockers and other compartments should be suitably provided with heavy-duty doors.

(viii) All the lockers should have self-draining of all wash down water.

(ix) Grab rails and non-slip steps should be provided to give access to the roof of the appliance and for easy and speedy removal and mounted of ladders.

(x) No part of the bodywork should reduce the ground clearance to less than 36 cm or increase the

overall width more than 2.42 m. The highest part of the appliance with the ladder and monitor mounted on its should not exceed 3.6 m from ground level. The construction of superstructure should not reduce the angles of approach and departure below 30°.

(xi) Stability : The stability of the appliance should be such that when under fully equipped and loaded condition if the surface on which the appliance stands is tilted to either side, the point at which over turning occurs is beyond a angle of 27°.

4.4.3 EQUIPMENT

Following equipment should be provided with the tender.

(A) HYDRAULIC SPREADER & CUTTER

(B) PNEUMATIC LIFTING SYSTEM

One set of air lifting bag should be provided with the emergency rescue tender. The Air Lifting Bag should have the capacity of minimum 10 metric tons, manufactured out of neoprene reinforced by kevlar threads. The bags should be fitted with specially designed non-return couplings.

(C) LOW TEMPERATURE GAS PROTECTIVE SUITS

(i) Low temperature gas protective suits with gloves suitable for LPG / Propane and other Toxic Hazardous Gases should be available in Emergency Rescue Tender.

(ii) The suit should be polyamide fabric coated with viton/sligon, sewn with chemical resistance special thread to ensure leak proof.

(iii) The suits should be boiler type one piece suit having joints sealed with gas tight zipper, wrist, flexible sleeves to prevent entry / splash or chemical vapour in body, having arrangement for keeping Breathing Apparatus set.

(iv) Gloves should be covered with neoprene as an extra protection and should be fixed / tight with wrist.

(v) This suit should be packed in HDPE / PVC Suitcase with hangers and anti-stick chemical should be supplied along with suit for long life of the suit and keep in.

(vi) The suit with gloves should be approved by Govt. Recognized laboratory certifying for safe use of LPG / Propane & resist minus temperature upto 50 deg. C. For a duration of 30 minutes.

(vii) Vendor should also submit copy of test report of low temperature gas protective suit for its low temperature resistance and gas tightness test of any Govt. Recognised Laboratory along with offer.

(D) FIRE ENTRY SUIT

(i) Fire entry suit should be available in emergency rescue tender. The suit should be suitable for total LPG fire entry with temperatures upto 1650 degree centigrade in the presence of a water / fog / sprayer system up-to a maximum duration of one minute and for long duration where the fire is less intense.

(ii) All components of the complete suit comprises of hood with tempered glass and gold plated lenses, coat with

accommodation for breathing apparatus, pants with sewn on suspenders, boots with wire reinforced sole and mitts.

(iii) The fire entry suit should have outer layer of aluminised fabric which provides protection from radiant temperatures upto 1650 deg. Centigrade in the presence of water/fog/sprayer system.

(iv) The fabric used for the suit should have approval of Underwriters Laboratories UL 214.

(E) FIRE PROXIMITY SUIT

Fire Proximity Suit should be available in Emergency Response Vehicle.

The suit should be made up of aluminised glass fabric. It should be stitched with fire retardant Kevlar yarn or equivalent threads. The material used for the suit, should not chemically react with water and should not show any tendency to absorb oil, grease, petrol etc.

The suit should include hood, coat, pants, boots, mitts and pouch suitable for accommodating BA set. Shoes should be of standard size with proper insulation and leather lining with non-skid type sole. Metal zip fasteners should be provided for easy donning and removal of the suit. The time required for donning the suit should not be more than 1.5 minutes.

No discomfort should be experienced while climbing a ladder, in running while carrying a pressurised hose pipe or first aid box. The suit should get dried easily. The complete set with maintenance manual should be packed in a strong case / box.

The suit should include following components:

Hood: Full shoulder length drape, adjustable underarm straps, built-in shell for structural support, hard cap with ratchet suspension, speedy clip for hard cap support, gold plated lens window and aluminium retainer, two side wing locks for holding lens and retainer in place etc. are the basic requirements of a hood.

Coat: There should be adequate space for keeping Breathing Apparatus. Double storm fly front, flame seal with drawstring at coat bottom required.

Pant: High waist design, approx 2” wide adjustable suspenders, adjustment straps on leg bottoms.

Boots: Designed to fit over work shoes. Leather insulated non-skid soles, adjustment tightening straps.

Mitts: Gloves with aluminised back and cuff and heat resistant palm.

Shelf life: Minimum 10 years.

Protection Level: Outer shell fabric should withstand a radiant temperature of 1093^{o} approx.

Size: Regular size suitable for a fireman of height 5’6” to 6’2” approx.

Certification: The fabric of the fire proximity suit should conform to the following standards / specifications :

a) Listed by Underwriters Laboratories UL 214.

b) U.S. Coast Guard Spec. No.164 009.

c) U.S. Military spec. MIL-C-0020079H.

d) U.S. Military spec. MIL-I-24244C.

e) NFPA spec. No.701.

f) UL 723

Flame spread - 0

Smoke density - 0

Fuel contributed - 0

INSPECTION

- Verify that the material meets all the details mentioned in the specifications.
- "Donning time" to be checked / observed and recorded.
- If the suit is Imported, Visual Inspection of the suit to be carried out.
- If the suit is indegeniously manufactured then Inspection should be carried out in two stages as below:

a. The inspection agency should visit the works of the vendor and draw the sample of the Fabric used for the manufacturing of the Fire Suit on a random sampling basis. The fabric mayl be sent to DIFR for testing and to ascertain the capability of the fabric for Fire Suit. On receipt of satisfactory approval, the vendor should be permitted to proceed with the manufacturing of the Fire Suit.

b. On satisfactory completion of the manufacture of Fire Suits, the inspection Agency should visit the works of the vendor and draw a sample of the Finished Suit and should seal the batch. The Selected Suit should be sent to DIFR for testing. Fabric from the pant area (lower torso), Shirt Area (Upper torso), Hood Area should be cut and tested at DIFR to verify the compliance of the Fabric used for Fire Suit.

c. In view of the destructive test, it is suggested that the following sampling size be followed:

One Sample to be tested for Twenty Suits or part thereof.

d. On receipt of satisfactory report, Third Party inspecting agency may release the batch of the suits duly sealed by them. They should also forward copy of the test report of DIFR alongwith their reports.

(F) LEAK SEALING PAD (VACUUM TYPE)

(i) 0ne Set of Leak Seal Pad for instant sealing of leaky containers of petroleum products preferably in storage tanks and bulk carriers should be provided with the Emergency Rescue Tender.

(ii) Leak Seal Pad should consist of built in air driven vacuum device which creates a vacuum for holding the pad firmly on the container. A separate chamber covers the hole and allows to seal it or drain the products from the leaking container.

(iii) This sealing pad should be provided with all necessary hoses and air connection, PVC pumps etc. complete with necessary valves, gauges etc.

(iv) The PVC pump should be equipped with a check valve to hold the vacuum.

(G) **LEAK CONTROL KITS**

(i) One set of Leak Control Kit should be suitable for sealing internal pipes, external pipes, large external pipes, drums, containers, small or large tanks & general purpose leakages. These kits should consist of normally anticipated things for attending an EMERGENCY CALL with accessories like Screw & T patches, Taper surface plugs, ball surface plugs, quick sealing epoxy putty, lead wool for sealing fatigue cracks, wooden plugs with wedged ends and felt covers, spanners etc. to seal the leakage from small (pin holes) to medium holes in any type of tanks /container /pipes. Bright yellow tape for barricading with bold lettering should be provided along with the control kit.

(ii) LEAK CONTROL KIT FOR INTERNAL PIPES: Internally leaking pipes can be controlled with the help of this kit without sealing/removing off from the surrounding pipes. The kit should be capable not only to plug pipe leakage but also allow to remove the contents to safe area with controlled flow or for flaring.

This kit should consist normally anticipated things needed for attending an Emergency Call for internal pipes leak and should accommodate plugs of different sizes with by pass valve, tools, wedges, transfer hoses and closing plugs etc.. The kit should be capable to seal any pipes having internal dia. from 1" to 4". All the above equipment should be provided in a handy carry box of robust construction.

(III) LEAK CONTROL KIT FOR EXTERNAL PIPES: Externally leaking pipes can be controlled with the help of this kit without sealing/removing off from the surrounding pipes.

This kit should consist almost all things needed for attending an Emergency Call for external pipes leak and should accommodate pipe bandages for different sizes ranging from 1/2" to 4", metallic covers, soft/hard neoprene lining and tools. The kit should be capable for controlling on low pressure pipes carrying water, air, fuels, gases, chemicals etc. All the above equipment should be provided in a handy carry box of robust construction.

(iv) LEAK CONTROL KIT FOR LARGE EXTERNAL PIPES: Leakages from small to medium holes in any type of natural pressure drums / containers and tanks should be controlled by this kit. The kit should be capable of sealing any type of holes such as cover pin, convex, concave, cover cracks, hair line cracks and flat/taper surface holes of any shapes.

The kit should consist almost all things need for attending any Emergency Call and should consist of crew & T-Patches, taper surface plugs, ball surface plugs, quick sealing epoxy putty, lead wool for sealing fatigue cracks, tools, wooden plugs with wedge ends and felt covers, yellow tape for barricading with bold letters. All the above equipment should be

provided in a handy carry box of robust construction.

(v) LEAK CONTROL KIT FOR DURMS / CONTAINERS : Leakages from small to medium holes in any type of natural pressure drums / containers and tanks should be controlled by this kit. This kit should be capable of sealing any type of holes such as cover pin, convex, concave, cover cracks, hair line cracks and flat/taper surface holes of any shapes.

The kit should consist almost all things needed for attending any Emergency Call and should consist of stainless steel screws, headwool, barricade tape, neoprene patches, T Bolts, wooden wedges, tools, plugs etc. All the above equipment should be provided in a handy carry box of robust construction.

(vi) LEAK CONTROL KITS FOR LARGE HOLES OF SMALL / LARGE SIZES IN TANKS :

Leakage of small / large holes should be controlled with the help of this kit. Leakage occurred because of overturn of heavy trailor mounted tanks carrying hazardous chemicals / liquids should be sealed with the help of this kit. The leakage should be sealed without the help of wrapping chains / cables around the vessel.

The kit should consist almost all things needed for attending an Emergency Call and should consists of neoprene patches of 13” x 23” size with special metal support frame. Fixing of the patch should be done with the help of stainless steel T bolts with rings nuts and sixteen outer stainless steel bolts to form a perfect patching to the vessel. Necessary tools should supplied along with the kits. All the above equipment should be provided in a handy carry box of robust construction.

Bright yellow tape for barricading with bold lettering should be provided along with this control kit.

(A) PORTABLE GAS DETECTOR

(i) Multi Gas Detector / individual instrument for each gas suitable for measuring combustibles (LEL), Oxygen (O_2), Carbon Monoxide (CO) & Hydrogen Sulphide (H_2S) should be provided with the Emergency Rescue Tender. The detector should monitor four hazardous gases simultaneously / independently. The instrument should be designed for field friendly operation with large, bright gas / alarm indicators and one button operation.

(ii) The Detector should have measuring range of 0 – 100% LEL and individual LCD readouts for each gas. Permanently attached, dual mode motorised sampling pump monitors in either active samples mode or ambient diffusion mode and change modes at the flick of a switch should be provided.

(iii) It should be operated with rechargeable battery. It should be provided with low battery warning.

(iv) The detector should be light in weight .

(v) The detector should be provided with carrying case, 10 foot sampling hose and sampling probes equipped with quick connects for easy field use, 110 VDC charger, Ni-Cd batteries, earphone, wrist strap and quad

15 ltr. Calibration gas cylinder and calibration hose. The equipment should be intrinsically safe and CCE approved.

(I) **TRAFFIC CONTROL EQUIPMENT**

(i) One hundred (100) meter cordoning rope mode out of nylon of 16 mm dia. MS pipe of 3 feet height at a distance of 2 metres with provision to run the nylon cordoning rope. MS pipe will be 2” dia and with a base plate for resting and fixing cordon. MS pipe to be painted with red and white colour reflective paint.

(ii) HDP cone for traffic control having height of 2.5 feet having base of 12” dia marked with radium strips, stackable to save space.

(iii) Sign board of 30” x 12” made from 20 swg MS plate with heavy duty frame and folding stand painting with following : Road closed, LPG Gas Leak – Fire Hazard, No smoking – Danger,

The above marking should be of reflective material.

4.4.5 ERV for LPG Handling Emergencies

In addition to the requirements mentioned earlier, the ERV should have following facilities and should be approved by CCE.

LPG TRANSFER FACILITY

(i) The Transfer Facility should consist of LPG Compressor, LPG Pump. Electric Motor, Inlet and Outlet connections, Hoses etc.

(ii) Air Cooled LPG Compressor cum pump of 30 CFM capacity complete with 4 way valve and knock-out drum – (PTO driven) with vapour recovery facility.

(iii) LPG Pump : The pumps should be having the out of 150 to 250 LPM at 600 RPM coupled to Power Take Off Unit of the vehicle. Suitable gear box for transfer drive to be provided.

(iv) Electric Motor (1.5 HP FLP Group II A, Class II Insulation) driven centrifugal pump 300 LPM capacity to handle diesel, kerosene and motor spirit (petrol). Power connection to the motor to be taken from 5 KVA diesel generator installed in the vehicle.

(v) Inlet and outlet connections of compressor and pumps to be provided with piping, isolation ball valves. Suction and discharge lines to be provided with glycerine filled pressure gauges (Range 0. 300 psi).

(vi) LPG pump suction of 3” dia and discharge of 2” dia.

(vii) LPG Pump suction of 3” dia.

(viii) LPG Pipeline to conform to CSA 106 Grade B Sec. 40 Flanges to conform to ASA 150 ANSI B 18.5, ball valves to conform to 300 # ration BS 4460 with flanged ends. The end connection to the pipe should be flanged.

(ix)
Centrifugal pump for handling diesel kerosene and motor sprit be having suction of 1.5” dia and discharge of 1.5” dia. Pipelines to conform to IS:1978 Grade 210, Flanges to conform ASA 150 drill to ANSI B 18.5 rating 150, Gate valve to conform to 150 # BS 4460. The end connections of pipes should be flanged.

(x)
LPG Hoses – 4 Nos. of 2” NB x 15 meter long, working pressure 373 psi & 4 Nos. of 1.5” NB x 15 metres working pressure 500 psi conform to BS 4089 / 1968 should be provided.

(xi)
The hoses should have flanged ends. The hoses hoses should be provided with depressurising facilities. Suitable provision be made for storing hoses in compressor/pump compartment.

(xii)
2 Nos. of 3” POL hoses with ASA 150 standards with 3” flange at one end and 3” male coupling at the other end should be provided.

(xiii)
LPG Pump and Compressor should be firmly mounted on the Tender with anti-vibration pads.

(xiv)
LPG pump and compressor should be coupled to PTO Unit of the vehicle with arrangement for operating both at a time or one at time as the case may be; the arrangements should be through suitable gear box. Gear box of reputed make with lever arrangement for above changeover. Suitable lever to be provided in the compartment to operate compressor / pump at varying speeds.

4.4.6 ACCESSORIES

Refer item no. 4.1.11(A).

4.4.7 PAINTING & MARKING

Refer item no. 4.1.10.

4.4.8 STAGE INSPECTIONS

Inspections should be carried out for various materials / quality of work at various stages of procurement / fabrication / body building of the Tender.

4.4.9 ACCEPTANCE TESTS

Following tests should be carried out before accepting the vehicle either at manufacturer’s works or a place to be mutually agreed upon :

a) Road tests to check chassis, manufacturer’s rating for acceleration, maximum speed, braking efficiency and turning circle with appliance fully loaded.
b) Stability test.
c) When the vehicle is brought to a stop in 9 m when travelling at 32 KM/hr. fully loaded and manned on pavement without any adverse effect on mounted equipment.
d) All the equipment should be tested for rated performance

4.4.10 INSTRUCTION BOOK(S)

A set of illustrated books along with as built drawing, General assembly & line diagram for electrical circuits

for Tender for the guidance of the user, including both operating and normal maintenance procedures for the appliance, should be kept.

The books should include an item-wise and illustrated spare parts lists giving reference number to all wearing parts with a view to ensure that adequate number of such spare parts are made easily available, when necessary. All inspection and testing records including calibration and hydro-test certificates should be included in manual.

4.4.11 SPARES

A complete set of recommended spare parts for battery charger etc, should be available.

4.4.12 Registration of vehicle : Tender should confirm to MV Act 1988 and Motor Vehicles Rules therein.

4.5 DRY CHEMICAL POWDER (DCP) TENDER

4.5.1 Dry Chemical Powder (DCP) tender should have power steering in addition to the following.

4.5.2 DCP tender should comprise of one roof mounted monitor, two (2) dry chemical powder vessels, two (2) hose reels for DCP discharge, necessary control systems / electrical systems, communications system etc. mounted on a chassis. Materials used for fabrication to be specified in details with precautionary measures/treatment for avoiding corrosion and suitable for sea water service. Arrangement should be provided to expel the powder from each of the vessels through hose reels and overhead monitors.

The total weight of the tender should be within permissible limits of the chassis carrying capacity.

4.5.3 **DRY CHEMICAL POWDER VESSEL**

The appliance should have two (2) vessels for dry chemical powder each having the capacity of minimum 1000 Kg. The vessels should be designed, fabricated & inspected as per ASME Code VIII Div-I code. The material for the vessel should be as per ASME / BIS codes. The plates should be ultrasonically tested. Both the DCP vessels should be mounted on the chassis with suitable foundation arrangements. The corrosion allowance for shell & dished end should be taken as minimum 2.5 mm.

The vessel should have treatment of anti-corrosion on internal surface, either of lead tin alloy (tin not less than 10%) or of zinc epoxy paint.

The vessel should be designed for the maximum operating pressure of 15 Kg/sq.cm. Based on the design pressure the hydro test of the vessel should be done at 30 Kg/sq.cm. & the test certificate should be obtained for this test.

The DCP vessel should be cylindrical shape and should be hermetically seating type cap with easy means for removing for the purpose of re-filling dry chemical powder.

The vessels should be provided with pressure gauge, drain plug, safety valve set at pressure of 17 Kg/sq.cm.

The DCP vessel should be charged with dry chemical powder as per IS:4308. Permanent marking of dry chemical powder filling height should be considered to avoid over-pressurisation of cylinder.

4.5.4 **NITROGEN CYLINDERS**

Each DCP vessel should have its own expelling gas cylinder assembly to discharge dry chemical powder through a monitor or two DCP nozzles connected to hand reels.

Each DCP vessel should have independent expelling gas system consisting of minimum four (4) nitrogen cylinders of 60 litre water capacity to expel the total DCP, Flushing lines, checking pressure with 10% excess nitrogen gas. Nitrogen gas should be filled at max. of 160 Kg/cm2. The cylinder batteries should be mounted in a frame in horizontal position with easy & independent removal or placement of each battery. Nitrogen cylinder batteries should incorporate suitable pressure reduction valve for ensuring safety of the DCP vessel. The frame should have the anti-corrosive treatment. The efficiency discharge throw of each unit should not be less than 95% of the total charge.

Nitrogen cylinders should be provided with quick operating valve & should be approved by CCE. The DCP vessel should be provided with suitable device to maintain the fluidity of the powder at all times.

100% spare Nitrogen cylinders (8 Nos.) should be supplied along with the appliance separately with all the details as mentioned for main cylinders.

The main as well as standby cylinders will be on the chassis with changeover option & with the provision of measuring the pressure of each cylinder.

4.5.5 CONTROL PANEL

The operating levers, pressure gauges etc. should be mounted on the control panel at suitable panel at suitable location. Adequate lighting should be provided for the control panel.

4.5.6 DCP MONITOR

The monitor should be mounted on roof of the appliance. The monitor should be easily accessible & should have safe platform for operating it.

Discharge rate of monitor should be 15, 25, 40 Kg/Sec at 14 Kg/Cm2 through settings with easily operable lever provided to operate the ball valve on the monitor & should have quick locking / unlocking arrangement at desired position.

The throw of the monitor should not be less than 45 m horizontal and 25 m vertically. The monitor should be capable of rotating 360 Deg. In horizontal & 90 Deg. In vertical plane.

4.5.7 HOSE REEL

Minimum Two (2) hose reels should be provided at easily accessible location. The hose reel should be quick rolling type with ball bearing with external flushing connection. An arrangement should be made to prevent the overrunning of the hose. Each reel should be provided with 30 metre long high pressure pneumatic reinforced rubber hose of 30 mm bore fitted with trigger type pistol grip nozzle. The discharge rate of the powder should be 2.5 Kg/Sec as per amended IS-10993 through each nozzle and the throw should not be less than 10 m horizontally and 8 m vertically while working with both the hose reels. Refer OISD-STD-142 for additional information.

4.5.8 BODYWORK & STORAGE

Driver's cabin should be round shaped closed type single compartment without partition having sitting arrangement for 2 persons (Driver & Officer). In addition to this sitting arrangement

for 3 crew members should also be provided at the rear side of the cabin. Adequate lighting in the cabin should be provided. Driver's seat should be adjustable type. All seats should have foam cushion with good quality foam leather upholstery. Doors should be fitted with safety glasses & winding type regulators, plastic coated grab rails and non-slip steps wherever necessary.

The doors should be hinged in front, opening outwards and should have double catch striking plates. All steps and walkways, platforms etc. should be aluminium corrugated sheet of suitable thickness.

Adequate lockers should be provided for accommodating 2 Nos. BA sets, 4 Nos. fire hoses & 2 Nos. Nozzles. The lockers should be provided with internal automatic on-off lighting system with a master switch in the cab. The doors of the lockers should have efficient means for holding them closed by flush fitting spring loaded locks. The lockers should not be hinged at the bottom.

The construction of the body should not reduce the road clearance to less than 36 cm or increase the overall width of the vehicle to more than 2.5 m. The centre of gravity of the completed appliance should be kept as low as possible under all conditions of loading. Drag hooks or eyes of adequate strength should be fitted on each chassis member at front & rear & one towing hitch should be provided at the rear position.

The construction of superstructure should be of all steel nature and the appliance should be panelled internally & externally in aluminium sheets of 16 gauge. **Timber should not be used in body construction**

4.5.9 **ACCESSORIES & ADDITIONAL FITTINGS**

a) Electric siren : 24 Volts electric siren combine with public address system

b) Fog Lamp : 2 Nos. mounted in front of the vehicle

c) Reversing light : Should be mounted at a suitable place

d) Amber Blinker Light : One Amber revolving beacon should be fitted on the driver's cabin

e) Search light : Should be mounted at convenient position with electric cable of 30 m length. It should be easily removable type and should have a stand for fixing at ground (SS tripod)

f) Rear view mirrors : 2 Nos. on either side of appliance.

g) Traffic indicators : Should be of blinker type

h) Mudguards : Should be provided on wheels

i) Tool Box : Should be provided behind Driver's seat

j) Electrical wiring : Electrical wiring should be as per Petroleum Rules 76. Wiring should be done with best quality wired of FINOLEX or equivalent. Battery should be located in Driver's cabin below crew seat.

k) Spark arrestor (CCE approved) : Should be provided on exhaust pipe

l) Reflectors : Should be provided on rear & front side.

m) First Aid box

4.5.10 **PAINTING & FINISH**

The appliance should be spray painted in “Fire Red” (golden yellow optional) color marked with specified emblem.

5.0 FIRE FIGHTING CHEMICALS

Water is a common type of fire extinguishing agent used to quench many type of fires mainly by cooling / flooding the burning surface to cut it off from atmosphere. However,

for fires in petroleum handling installations, use of water as extinguishing agent gets limited to cooling only. In such cases, some fluid lighter than hydrocarbons, need to be applied to cut off oxygen supply from atmosphere to burning surface.

Various types of chemical foams / powders are used to extinguish petroleum fires. Requirements for some of these chemicals are given hereunder:

5.1 PROTEIN FOAM

This specification covers the requirements for Protein foam liquid concentrate fire fighting chemical consisting of hydrolised protein either from animal or vegetable source, foaming agents, stabilisers, preservatives and other compounds, as required, to conform to this specification.

The concentrate should conform to IS: 4989 (Part-1) - 1984 and bear IS mark.

At the time of use, the concentrate should be diluted to form a fire extinguishing solution for the fire extinction of hydrocarbon fuels

The Protein Foam concentrates should be suitable for use in foam generating equipment with fresh water or seawater with no loss in its performance.

In addition to being suitable for use at low expansion, the foam concentrate should have suitable stabilisers and preservatives to prevent decomposition due to micro-biological attach on foam compound during the storage.

The produced foam should essentially have a quick control time, good burn-back resistance, effective sustained sealing properties and low critical application rates. The shelf life of foam compound should be as per relevant Indian Standard.

CONCENTRATE CHARASTERASTICS

The concentrate should conform to the physical requirements as below :

Concentrate requirements	Values Max.	Min
Viscosity, at 27 ± 1 deg.C (Centistokes)	40	-
Hydrogen ion concentration (pH) for both original and conditioned sample.	7.5	6.5
Specific Gravity for both original & conditioned sample	1.18	1.13
Miscibility with water	Miscible	

/sea water		
Sludge contents (% v/v)		
Original sample	0.30 %	-
Conditioned sample	0.50%	-
Freezing Point	Should flow at (-) 5^0 C	
Microbial susceptibility	Should not be susceptible	
Expansion at 27±1 deg.C	-	6
25% drainage time	3mins 30Sec	2 minutes
at 27±1deg. C		
Fire test extinction time		
a) Control Time	2 Min	-
b) Extinction time	3 Min	-
Resistance to burn back (thermal stability)	-	10 Min
Sealability	-	10 Min

Storage
The concentrate should be capable of being stored in sealed containers for a period not less than 2 years at local ambient temperatures and conditions encountered without deterioration by chemical or bacterial action.

Homogeneity
The concentrate should be homogeneous. No solidification or separation of crystals or stratification should take place under the conditions stated in 3.3.

Test Methods / Procedures

Viscosity
Viscosity should be determined by method described in IS: 1206 (Part 3) - 1978, using viscosity meter Sl no iv of Table 2.

pH value
pH should be determined using a pH meter with glass electrode and reference electrode as per method specified in Appendix A of IS:4989 (Part 1) - 1985.

Specific Gravity
Specific gravity should be determined as per procedure prescribed in IS: 4989 (Part 1) - 1985 Appendix B.

Miscibility with water / Sea water (Optional)
Miscibility with water should be determined as per procedure prescribed in Appendix C IS: 4989 (Part 1) - 1985.

Sludge contents
Sludge contents should be determined as per procedure prescribed in IS: 4989 (Part 1) - 1985 Appendix D.

Freezing point (Optional)
Freezing should be determined as per procedure prescribed in IS: 4989 (Part 1) - 1985 Appendix E.

Microbial Susceptibility
Microbial Susceptibility test should be conducted as per procedure prescribed in IS:4989 (Part 1) -1985. Appendix F.

Expansion
Expansion test of the foam should be determined as per procedure described in IS: 4989 (Part 1) - 1985 Appendix H.

25% drainage Time.
25 % Drainage Time should be determined as per procedure described in IS : 4989 (Part 1) - 1985 Appendix K.

Fire Test Extinction Time
Fire test extinction time should be determined as per procedure described in IS: 4989 (Part 1) - 1985 Appendix K

Resistance to Burn-Back.
Resistance to burn back should be determined as per procedure described in IS : 4989 (Part 1) - 1985 Appendix N.

Sealibility.
Sealibility should be determined as per procedure described in IS : 4989 (Part 1) - 1985.

PACKAGING
Packaging of foam concentrate should be as per IS: 4989 (part 1) 1985.

QUALITY ASSURANCE

The foam manufacturer should have all test facilities to carry out quality control tests of the foam produced in his premises.

Before acceptance of the ordered foam, the manufacturer should arrange for conducting all the tests specified in this specification (on a sample randomly drawn from dispatch ready lot of the ordered foam) for ensuring quality of the foam being supplied.

5.2 FLUORO-PROTEIN FOAM

5.2.1 GENERAL

I. This specification covers the requirements for Fluoro-Protein foam liquid concentrate fire fighting agents consisting of hydrolised protein either from animal or vegetable source, fluorinated surface active agents, foaming agents, stabilisers, preservatives and other compounds, as required, to conform to this specification.

II. The concentrate should conform to IS: 4989 (Part-3) - 1987 and bear IS mark.

III. At the time of use, the concentrate should be diluted to form a fire extinguishing solution for the fire extinction of hydrocarbon fuels

IV. The Fluoro-Protein Foam concentrates should be suitable for use in foam generating equipment with fresh water or seawater with no loss in its performance.

V. In addition to being suitable for use at low expansion, the foam concentrate should have suitable stabilisers and preservatives to prevent decomposition due to micro-biological attach on foam compound during the storage.

VI. The produced foam should be essentially have a quick control time, good burn-back resistance, effective sustained sealing properties and low critical application rates.

VII. The shelf life of foam compound should be as per relevant Indian Standard.

5.2.2 CONCENTRATE CHARASTERASTICS

The concentrate should conform to the physical requirements shown below :

Concentrate requirements	**Values** **Max.**		**Min**
Viscocity, at 27 ± 1 o C (Centistokes)	40		-
Hydrogen ion concentration (pH) for both original and conditioned sample.	7.5	to	6
Specific Gravity for both original & conditioned sample	1.18		1.03

Miscibility with water /sea water	Miscible	
Sludge contents (% v/v)		
Original sample	0.30 %	-
Conditioned sample	0.50%	-
Freezing Point	Should flow at -5^0 C	
Microbial susceptibility	Should not be susceptible	
Performance requirements		
Expansion at 27±1 deg. C	-	6
25% drainage time	2 min 30 Sec	1 min 30 Sec
at 27±1 deg. C		
Fire test extinction time		
a) Control Time	60Sec	-
b) Extinction time	90Sec	-
Resistance to burn back (thermal stability)	-	12 Min
Sealability	-	15 Min
Film forming	Form aqueous film	

Storage
The concentrate should be capable of being stored in sealed containers for a period not less than 5 years at local ambient temperatures and conditions encountered without deterioration by chemical or bacterial action.

Homogeneity
The concentrate should be homogeneous. No solidification or separation of crystals or stratification should take place.

5.2.3 Test Methods / Procedures

Viscosity
Viscosity should be determined by method described in IS: 1206 (Part 3) - 1978, using viscosity meter Sl no iv of Table 2.

pH value
pH should be determined using a pH meter with glass electrode and reference electrode as per method specified in Appendix A of IS:4989 (Part-3) - 1987.

Specific Gravity
Specific gravity should be determined as per procedure prescribed in IS: 4989 (Part-3) - 1987 Appendix B.

Miscibility with water / Sea water (Optional)
Miscibility with water should be determined as per procedure prescribed in Appendix C IS: 4989 (Part-3) - 1987.

Sludge contents

Sludge contents should be determined as per procedure prescribed in IS: 4989 (Part-3) - 1987 Appendix D.

Freezing point (Optional)
Freezing should be determined as per procedure prescribed in IS: 4989 (Part-3) - 1987 Appendix E.

Microbial Susceptibility
Microbial Susceptibility test should be conducted as per procedure prescribed in IS: 4989 (Part-3) -1987 Appendix F.

Expansion
Expansion test of the foam should be determined as per procedure described in IS: 4989 (Part-3) - 1987 Appendix H.

25% drainage Time.
25 % Drainage Time should be determined as per procedure described in IS: 4989 (Part-3) - 1987 Appendix J.

Fire Test Extinction Time
Fire test extinction time should be determined as per procedure described in IS: 4989 (Part-3) - 1987 Appendix K.

Resistance to Burn-Back
Resistance to burn back should be determined as per procedure described in IS: 4989 (Part-3) - 1987 Appendix N.

Sealibility
Sealibility should be determined as per procedure described in IS: 4989 (Part-3) - 1987 Appendix M.

Film Formation
Film Formation should be determined as per procedure described in IS : 4989 (Part-3) - 1987 Appendix P.

PACKAGING
Packaging of foam concentrate should be as per IS: 4989 (part-3) 1987.

QUALITY ASSURANCE

(a) The foam manufacturer should have all test facilities to carry out quality control tests of the foam produced in his premises.

(b) Before acceptance of the ordered foam, the manufacturer should arrange for conducting all tests specified (on a sample randomly drawn from despatch ready lot of ordered foam) for ensuring quality of foam being supplied.

5.3 AQUEOUS FILM FORMING FOAM (AFFF)

5.3.1 GENERAL

(a) This specification covers the requirements for aqueous film forming foam (AFFF) liquid concentrate fire fighting agents consisting of fluorocarbon surfactants, foaming agents, stabilisers and other compounds, as required, to conform to this specification.

(b) The concentrate should conform to IS: 4989 (Part-2) - 1984 and bear IS mark.

(c) At the time of use, the concentrate should be diluted to form a fire extinguishing solution for the fire extinction of hydrocarbon fuels

(d) The AFFF concentrates should be suitable for use in foam generating equipment with fresh water or seawater

with no loss in its performance.

(e) In addition to being suitable for use at low expansion, the foam concentrate should have film formation characteristics at allow it to be used through non-aspirating nozzles/monitors.

(f) The produced foam should be essentially have a quick control time, good burn-back resistance, effective vapour sealing properties and low critical application rates.

5.3.2 TYPES OF FOAM CONCENTRATES

The foam concentrates should be of type specified in the purchase order, out of following types.

Type – 3 : To be used as 3 parts of concentrate in 97 parts of water v/v.

Type – 6 : To be user as 6 parts of concentrate in 94 parts of water v/v

5.3.3 CONCENTRATE CHARASTERASTICS

The concentrate should conform to the physical requirements as below :

Concentrate requirements	**Values**		
	Max.		**Min**
Viscosity, at 27 ± 1 deg. C (Centistokes)		40	-
Hydrogen ion concentration (pH) for both original and conditioned sample.	7.5	to	7.0

Specific Gravity for both original & conditioned sample	1.1	1.0
Miscibility with water /sea water	Miscible	
Sludge contents (% v/v)	0.25%	-
Freezing Point	Should flow at -5^0 C	
Film Formation	Forms Aqueous Film	
Spreading coefficient	-	4.5
Expansion at 27±1 o C	12	8
25% drainage time at 27±1oC	-	90 Sec
Fire test extinction time	60 Sec	-
Resistance to burn back (thermal stability)	-	8 Min

Storage

a) The concentrate should have shelf life as per relevant Indian Standard.

b) The foam compound should be tested every 3 years at random.

Homogeneity

The concentrate should be homogeneous. No solidification or separation of crystals or stratification should take place.

Compatibility

The foam produced from the concentrate should be compatible with dry chemical powder.

5.3.4 Test Methods / Procedures

Viscosity

Viscosity should be determined by method described in IS : 1206 (Part 3) - 1978, using viscosity meter Sl. No. iv of Table 2.

pH value

pH should be determined using a pH meter with glass electrode and reference electrode as per method specified in Appendix A of IS:4989 (Part 2) - 1984.

Specific Gravity

Specific gravity should be determined as per procedure prescribed in IS: 4989 (Part 2) - 1984 Appendix B.

Miscibility with water / Sea water (Optional)

Miscibility with water should be determined as per procedure prescribed in IS : 4989 (Part 2) - 1984.

Sludge contents
Sludge contents should be determined as per procedure prescribed in IS : 4989 (Part 2) - 1984 Appendix D.

Freezing point (Optional)
Freezing should be determined as per procedure prescribed in IS: 4989 (Part 2) - 1984 Appendix E.

Film formation
Film formation test should be conducted as per procedure prescribed in IS: 4989 (Part 2) -1984. Appendix G. However, details of nozzle and method of foam generation should be as described in Appendix F of IS: 4989 (Part 2) - 1984.

Spreading coefficient
Spreading coefficient should be determined as per formula / method described in IS: 4989 (Part 2) - 1984 Appendix H.

Expansion
Expansion test of the foam should be determined as per procedure described in IS: 4989 (Part 2) - 1984 Appendix J.

25% drainage Time.
25 % Drainage Time should be determined as per procedure described in IS: 4989 (Part 2) - 1984 Appendix K.

Fire Test Extinction Time
Fire test extinction time should be determined as per procedure described in IS: 4989 (Part 2) - 1984 Appendix L.

Resistance to Burn Back
Resistance to burn back should be determined as per procedure described in IS: 4989 (Part 2) - 1984 Appendix M.

5.3.5 PACKAGING

Packaging of foam concentrate should be conforming to IS-4989 (part –2) 1984.

5.3.6 QUALITY ASSURANCE

The foam manufacturer should have all test facilities to carry out quality control tests of the foam produced in his premises.

Before acceptance of the ordered foam, the manufacturer should arrange for conducting all the tests specified in this specification (on a sample randomly drawn from dispatch ready lot of the ordered foam) for ensuring quality of the foam being supplied.

5.4 ALCOHOL RESISTANT FOAM OR ALCOHOL TYPE CONCENTRATE

5.4.1 GENERAL

This specification covers the requirements for Alcohol Resistant Foam (ARF)) liquid concentrate fire fighting agents consisting of fluorocarbon surfactants, foaming agents, stabilisers and special polymers to make it useful on polar solvents.

At the time of use, the concentrate should be diluted to form a fire extinguishing solution for the fire extinction of Polar solvents (water miscible) fuels.

The ARF concentrates should be suitable for use in foam generating equipment with fresh water or seawater with no loss in its performance.

In addition to being suitable for use at low expansion, the foam concentrate should have film formation characteristics at allow it to be used through non-aspirating nozzles/monitors.

The produced foam should be essentially have a quick control

time, good burn-back resistance, effective vapour sealing properties and low critical application rates.

5.4.2 CONCENTRATE CHARASTERASTICS

The concentrate should have all the properties of AFFF and additionally should be suitable for use on polar solvent fires.

HOMOGENEITY

The concentrate should be homogeneous. No solidification or separation of crystals or stratification should take place under the normal storage conditions

COMPATIBILITY

The foam produced from the concentrate should be compatible with dry chemical powder.

PACKAGING

Packaging of foam concentrate should be conforming to IS-7959.

5.4.3 STORAGE

a) The concentrate should have shelf life as per relevant Indian Standard.

b) The foam compound shall be tested initially, after 3 years of purchase and subsequently

5.4.4 QUALITY ASSURANCE

The foam manufacturer should have all test facilities to carry out quality control tests of the foam produced in his premises.

Before acceptance of the ordered foam, the manufacturer should arrange for conducting all the tests specified in this specification (on a sample randomly drawn from dispatch ready lot of the ordered foam) for ensuring quality of the foam being supplied.

5.5 DRY CHEMICAL POWDERS

It should meet the requirements of IS: 4308 of Bureau of Indian Standard and should be ISI marked.

PHYSICAL / PERFORMANCE PARAMATERS

S.No.	Description	Value
1.	Apparent Density	0.75 - 1.18 gm/l

2.	Particle size distribution	-100% through sieve of 120 um
		-95% --------- do ---------- 75 um
		-10% --------- do ---------- 25 um
3.	Hygroscopicity and caking	should meet test requirement of IS-4308
4.	Water repellency	as per IS-4308
5.	Free flowing characteristics	as per IS-4308
6.	Heat test	as per IS-4308
7.	Fire knocking properties	should meet test requirement of IS-4308
8.	Foam compatibility	should be compatible with fire fighting foam

Note : (1) Test for Sodium based Dry powder should be conducted with 60 +/- 5 gm of powder.

(2) Test for Potassium based Dry powder should be conducted with 30 +/- 3 gm of powder

PACKING

The powder should be packed in hermetically sealed moisture proof bag which is in turn pack in a HDPE / metal drum. Pack size should not exceed 50 kgs.

PACKING TEST

Randomly selected bag of Dry powder should be submerged in water for 5 minutes. The powder should be checked, after drying the bag from outside. That no moisture should enter the bag.

SHELF LIFE

Shelf life should be minimum 5 years under sealed condition when stored at ambient condition.

6.0 FIRE EXTINGUISHERS

6.1 DCP FIRE EXTINGUISHERS **(5/10 Kgs) ;** (TROLLEY MOUNTED) **25 / 50 / 75 KGS**

6.1.1 DESIGN OF DCP CYLINDERS

(a) DESIGN PRESSURE

The portable trolley mounted fire extinguishers and the DCP cylinder on mobile tenders should be designed to withstand pressure of 22.5 kg/sq cm. The maximum operating pressure should not exceed 15kg/sq.cm. This pressure should be adequate to achieve required performance characteristics.

(b) MATERIAL OF DCP CYLINDER

The material of various parts of the DCP cylinder should be as given below:

i) Shell of all portable cylinders upto 10 kg capacity — IS-513 grade 'EDD'or "DD"

ii) Shell of all trolley mounted cylinders upto 150kg — IS-2002 grade A or IS-2041

iii) Shell of mobile tender : IS-2002 gr 2A or IS-2041

iv) Nozzle pipe : IS-1239/IS-1978

v) Flanges : ASTM A-105 or equivalent

vi) Plunger and nozzle of all portable cylinders upto 10 kg capacity ; Type I of IS-319

vii) Cap nozzle and drain plug of all trolley mounted extinguishers upto 150 kg capacity. : Type I of IS-319/ SS

viii) Discharge nozzle on trigger for cylinder, portable and trolley mounted : IS-617

ix) Washers for all sizes of extinguishers : IS-5382 / IS-2171

x) Inner container : IS-513 / IS-2171

(c) DESIGN THICKNESS

The thickness of plate material for the DCP cylinder should be calculated as per the formula given below:

$$t = \frac{PD}{200\ fj + P}$$

where

t = minimum thickness of shell plate exclusive of corrosion allowance in mm.

P = Design pressure in kg/cm2

D = outside diameter of DCP cylinder in mm.

f = allowable stress value for the material used in kg/mm2

j = weld joint efficiency factor

Thickness of the shell including dished ends should not be less than 2 mm for portable extinguishers upto 10 Kg, 3.15 mm for 25 Kg, 50 Kg & 75 Kg and 6.3 mm for 100 Kg & above trolley mounted extinguishers respectively.

(d) CAPACITY

The capacity of portable extinguishers should be of 1, 2, 5 and 10 kg weight of Dry Chemical Powder and of trolley mounted extinguishers of 25, 50, 75, 100 and 150 Kg weight. The mobile tender capacity shall be of 300 Kg, 500 Kg, 1, 2, 3 & 4 Tonnes by weight.

6.1.2 CONSTRUCTION

(i) WELDING

The cylinder body should be of welded type. All ferrous fittings should be welded to the body while all non-ferrous fittings should be brazed.

i) All welding should be carried out using qualified welders and agreed welding procedures.

ii) The weld joint design for the long seam as well as the circumferential seam should be of the square edge butt type for plate thicknesses 3.0mm and less and single "V" butt for thicknesses higher than 3.0mm.

iii) All welding should be carried out using shielded metal arc welding (SMAW) or gas tungsten arc welding (GTAW) techniques only. The electrode for welding should conform to AWS/ASME classification. The electrode diameter should be chosen considering plate thickness to be welded.

iv) All butt welds should be full penetration welds.

v) All other requirements as outlined in section II of IS-2825 should be followed.

(ii) SAFETY VALVE

All trolley mounted DCP extinguishers should be provided with safety valve preferably on its top dished end to requirements of IS-2825.The set pressure should be 17 Kg/sq.cm.

(iii) OPERATING PRESSURE

Suitable test should be done to demonstrate that sufficient space is provided so that internal pressure does not exceed 15 Kg/sq.cm and the body should not show any sign of leakage if the discharge nozzle is closed and the extinguisher is operated at 27 + 2ºC.

(iv) DRY CHEMICAL POWDER

The types of Dry Chemical Powder and requirements should be as per item no. 5.5.

(v) EXPELLANT GAS

The Expellant gas used should be carbon dioxide (CO2) or nitrogen (N2). The maximum quantity of expellant gas to be used for various capacities of Dry Chemical Powder Extinguishers should be such that the internal pressure of the DCP cylinder should at no point of time exceed 15 kg/sq.cm.

(vi) HOSE

The length of the discharge hose should be as specified in IS-2171 and IS-10658.The hoses should be designed to withstand the design pressure of the DCP cylinder.

(vii) DISCHARGE NOZZLE

The discharge nozzle should be designed to discharge the powder as per performance characteristics outlined in 4.0.

(viii) CAP/FILLER OPENING

The size of cap/filler opening should be as per IS-2171 (latest edition).

(ix) VENT HOLES

Necessary vent holes should be provided as per IS-2171

(x) SAFETY CLIP

Safety clip should be provided to prevent accidental actuation of piercing mechanism.

(xi) COATING

The internal and external surfaces of the cylinder body should be coated with Zinc or lead-tin alloy. Thickness of Coating for various sizes should be as specified in standards IS-2171 and IS-10658.

(xii) PAINTING

The extinguisher should be painted fire red conforming to shade No.536 of IS-5. The paint should conform to IS-2932. For further details refer OISD-STD-142.

6.2 CO_2 EXTINGUISHER

CO2 type fire extinguisher of 2, 3, 4.5, 6.8, 9 and 22.5 kgs assembled out of seamless steel cylinder having CCE approval and ISI mark complete with wheel type valve, high pressure wire braided discharge hose with horn and carrying handle. The cylinder should be fully charged with CO2 Gas. All other components, design & performance, anticorrosive treatment should be as per IS:2878 latest.

For specifications and other details also refer OISD-STD-142.

7.0 WATER / FOAM MONITORS

7.1 WATER MONITORS

Water monitors should be conforming to IS: 8442-1977 and IS marked

The capacities of monitors should be of following sizes :

SIZE	HORIZONTAL THROW	DISCHARGE CAPACITY
(mm)	(m)	lpm
63	53	1750
75	60	2580
100	64	3500

7.2 WATER CUM FOAM MONITOR - STRAIGHT JET TYPE

Water cum Foam Monitor having swivel joints for rotation in horizontal and vertical direction with self educting non-aspirating type nozzle and its discharging head to jet water or foam as per choice. The monitor can be fixed type and can be mounted on stand post. There will be stainless steel ball valve on the discharge nozzle itself for controlling the foam intake to the nozzle. Connected to the nozzle ball valve, 3 mtrs long transparent braided PVC hose with stainless steel pipe would be provided for inserting into the foam cans/drums for induction. The Hose would be detachable.

The sizes and the capacity of the monitor shall be same as 7.1 except IS marking and this monitor shall have aeration facility for foam generators. The material of construction shall be as per IS : 8442.

The monitor shall be provided with pick up tube and ball valve.

JEEP TYPE TRAILOR CHASSIS

The trailor chassis should be of 6 ft. x 3 ft. and made our of 3" x 1/2" channel complete with pneumatic tyre and tubes 600 x 16 x 6 ply, mudguard, 2 Nos. shock absorbers, lead springs, forged spring loaded towing eye. The trailor chassis should be complete with sturdy jacks capable of resisting back pressure, axle of 50 mm x 50 mm square, automatic and manually operated hand brake and over-run brake, reflector, tail lamp, number plate and platform should be provided covered with aluminium chequered plate of 3.15 mm thickness.

7.3 MULTIPURPOSE (4-in-1) AQUA - FOAM - DCP - FOG TYPE MONITOR WITH NOZZLE 3500 lpm CAPACITY (TRAILOR MOUNTED TYPE)

Long Range Water Monitor of 3500 lpm capacity have additional facilities to give discharge with fog, spray and jet arrangement with water, foam & DCP. The monitor should be fitted with non-aspirating type Multipurpose (4-in1) Nozzle. The monitor should be fixed type and mounted on trailer.

The detailed specifications of the unit are given here under:-

A) Size : 4 inches

b) Body : MS seamless steel pipe, bend etc. duly treated with anti-corrosive paint, gun metal swivel joint for horizontal and vertical movement duly covered gear operation.

Rotation : 360 degree

Elevation : 90 deg (+75 deg, - 15 deg)

Swivel Joint

a) Material : LTB-Gr 2 of IS : 318

b) Gear : LTB-Gr 2 of IS : 318
Wheel

c) Worm : Gunmetal

Nozzle

a) Material of construction :
LTB-Gr 2 of IS : 318

b) Type of foam used : AFFF/ATC

c) Discharge capacity : 3500 lpm

d) Throw at 7 kg/sq.cm pressure at nozzle :

Horizontal (minimum)

Water : 64 m

Foam : 60m

DCP (with foam) : 45m at nozzle water pressure of 7 kg/sq.cm

e) Foam Expansion : Min. 1:3/4

f) Fog (curtain) : 160 deg.

g) K-Factor : 100

h) Friction loss : Less than 10 psi through monitor

i) Semi Fog for tank cooling and dissipation of vapours and gases at a distance of 10m and above

7.4 WATER CUM FOAM MONITOR WITH FOG AND JET FACILITY

The monitor should be fitted with self educting non-aspirating type water cum Foam Nozzle. The monitor should be fixed type and can be mounted on stand post. There will be a stainless steel ball valve for controlling the foam intake to the nozzle connected with 5 meters long PVC hose with stainless steel pipe should be provided for inserting into the foam cans/drums for induction. The Hose would be detachable. The detailed specification with discharge parameters are given below.

The capacities and sizes should be as follows :

MONITOR

a) Body : M.S ./ S.S. 304 or 316 Seamless pipe

b) Rotation : 360 degree

c) Elevation : 90 deg. (+75 deg., - 15 deg.)

SWIVEL JOINT

a) Material : LTB-Gr.2 of IS 318

b) Gear Wheel: LTB-Gr.2 of IS.318

c) Worm : Gunmetal

SELF INDUCTION NOZZLE

a) Material of construction : Anodised Aluminium / GM / SS 304 or SS 316

b) Type of foam used : AFFF

c) Foam Expansion : 1:3-4

d) Fog (curtain) : 160 deg. for personal.

e) K-factor : 100

f) Friction Loss : Less than 0.7 kg/cm2 through monitor.

FLANGE

a) Material : Mild Steel /SS 304 or SS 316

b) Specification : ANSI-B-16.5 # 150 R with FF serrations

Other construction details

Size	Capacity	Horizontal water throw	Horizontal foam throw
(mm)	(lpm)	(m)	(m)
75	2580	60	55
100	3840	70	64
150	7680	75	70

A) Welding : GTAW with ER309 MOL electrode or equivalent and 100 % radiography

B) Working Pressure : 7 kg/sq.cm

C) Painting : As per IS : 5 with two coats of red enamel paint

7.5 TRAILERS WITH FOAM TANK FOR MONITORS

Foam tank trailer with foam tank capacity of 1000/2000 lit MS / SS 304 / SS 316 with suitable monitor. The trailer of suitable capacity made out of MS/SS 304/SS 316 channels of 75 mm x 5 mm thickness with MS / SS 304 / SS 316 plate of minimum 5 mm thickness welded and duly treated for anti-corrosion mounted on two standard make tyres with solid beam axle on heavy duty. Semi-elipticle springs which can take the load of entire unit.

It should be provided with Towing eye of 80 mm dia in front of trailer, brake system and 4 nos. of supporting legs.

8.0 OTHER EQUIPMENT

8.1 SIREN

(A) Electrically Operated Siren

The general requirements, 3 phase electric motor, siren, heads, starter for on/off operations, without warbling relay, acoustic power should comply with IS:1941 (Part I)/1976. The Siren should have a range of minimum 3.0 kms. Siren should be horizontal complete with mounting. The electric motor should be totally enclosed with greased sealed ball bearing and should conform to IS:325.

(B) Hand Operated Siren

The shape, components, material, design and construction should comply with IS:6026-1970. It should have portable stand as per para 6.3 of IS:6026 of IS:6026. The Siren should have a range of minimum 1.6 kms

8.2 FIRE HOSES

63 mm / 38 mm and minimum 15 meter. long cotton / synthetic fibre seamless circular woven jacketed, rust proof, rubberised fabric reinforced rubber lined fire hose, bearing IS:636/1988 Type A & B mark capable of withstanding 35.7 Kg. bursting pressure, binded with gunmetal instantaneous type male and female coupling bearing IS:903 mark with copper wire.

8.3 FIRE HOSE BOX

(a) M.S. Fire Hose Box

Fire Hose Box manufactured out of 18 SWG thick M.S. sheet size 750 mm x 600 mm x 250 mm (30" x 24" x 10" approx.), suitable for accommodating 02 Nos. 63 mm dia. fire fighting hose in length of 15 m with nozzle. The box should be provided with double door and should have locking arrangements. Provision for break glass recess for key should be given in the box. The front doors should be provided with transparent acrylic sheet fitted with rubber beading for transparency. The hose box should be painted with two coats of enamel paint of fire red colour on the external surfaces and white colour on the internal surfaces over two coats of zinc chromate primer. The box should be capable to resist the weight of hoses with couplings. Suitable wall mounting bracket should be provided in the box.

(b) FRP Fire Hose Box

Fibre Glass Fire Hose Box size: 750 mm x 600 mm x 250 mm (30" x 24" x 10" approx.), moulded out of Fibre Reinforced Plastic (FRP) suitable for accommodating 02 Nos. of 15 metre Fire Fighting Hose with nozzle. The box should be provided with double door and should have locking arrangements. Provision for break glass recess for key should be given in the box. The front doors should be provided with transparent acrylic sheet fitted with rubber beading for transparency. The box should be painted with red colour glossy finish. The box should be capable to resist the weight of hose with couplings. Suitable wall mounting bracket should be provided in the cabinet.

8.4 NOZZLES AND BRANCH PIPES

8.4.1 Nozzles

Fog Nozzle

Fog Nozzles made out of gunmetal chromium plated suitable for 63 mm dia fire hose, having arrangement for straight stream, high pressure fog and shut off as per IS: 952 and with couplings as per IS:903.

Universal Nozzle (Triple Purpose Nozzle)

Universal nozzle made out of gunmetal chromium plated suitable for 63 mm dia fire hose with instantaneous coupling as per IS: 903, capable of giving high pressure jet and fine water curtain as per IS:2871.

Water Curtain Nozzles

Water curtain nozzles made out of gunmetal with chromium plated suitable for 63 mm dia fire hose with instantaneous couplings suitable for curtain as per IS: 903.

Jet Nozzles

Jet nozzles with branch pipes made out of gunmetal suitable for 63 mm dia fire hose with instantaneous coupling and 16 mm dia. Nozzle orifice capable of discharging 450 lpm at 7 Kg/cm2 as per IS: 903 with ISI Mark.

8.4.2 BRANCH PIPE

Gunmetal branch pipe 63 mm dia. with gunmetal nozzle conforming to IS: 903, TAC approved and bearing ISI Mark.

Foam Making Branch Pipe

Foam making branch pipe complete with pickup tube and strainer, FB 5X, al. alloy, capacity 225 lpm at 7 Kg/cm2 pressure with regulating valve and pickup tube as per IS: 2097.

8.5 WATER BASED JEL BLANKET

In Fire Protection & life saving "Jel Soaked Blanket" of various sizes, the jel system should be a combination of an outer layer of 100% new wool having an intercellular weave with a therapeutic jel that is non-toxic, bactericidal, water-soluble and biodegradable. The wool carried is capable of absorbing upto 13 times its own weight. The Water based Jel Blanket should be packed in good quality poly-jar / canister. Water Jel Blanket should be having 3 years shelf life for medical purpose and 5 years for fire emergencies.

8.6 EXPLOSIMETER

Portable light weight, hand held intrinsically safe instrument for monitoring the possibility of explosive atmosphere having CCE /DGMS approval / UL listing.

8.7 SELF CONTAINED BREATHING APPARATUS (WITH ONE SPARE CYLINDER)

CCE Approved Positive pressure double stage SCBA suitable for fighting, rescue operation in toxic and oxygen deficient atmosphere. The equipment consists of compressed air cylinder, light weight, full face wide vision mask (with inner ori-nasall mask), speech diaphragm, spring loaded exhalation valve, L.P. warning whistle, pressure gauge, positive pressure demand valve working on pneumatic pressure, comfortable shoulder harness and light weight chemical resistant back plate to accommodate cylinder. The hoses are made from Neoprene Rubber/steel braided. The facility of automatic cut-off of the air flow up on disconnection of the reducer should be available. It should be as per IS: 10245 (part-4) 1982. Refer OISD-STD - 155 for additional information.

8.8 FIRE ESCAPE MASK / FILTER TYPE EMERGENCY RESPIRATORS

Emergency respirator is a self rescue hood, ideal for escape from room and buildings contaminated with toxic fumes and gases created by fire or accidental pollution. It should be as per IS: 8523 - 1977.

8.9 TORCHES

Torches should be intrinsically safe for use in zones o1 and should be CCE approved.

8.10 RESCUCITATOR

It should be as per IS: 6194 , 1971

9.0 FIRE FIGHTING PERSONNEL

Petroleum installations like Crude oil exploration & production sites, crude oil transportation, refining, transportation of petroleum products, gas processing plants, marketing depots & terminals and LPG plants have different ways of manning fire fighting facilities. Larger and complex installations like refineries have ful-fledged fire and safety department where as other smaller installations man their fire fighting facilities with the man power available for operations.

Though fire fighting facilities are provided to meet emergencies, it is very much essential that such facilities are operated by competent

personnel in a right way. Therefore, the industry should develop own set of standards / requirements for personnel being deployed to man fire fighting facilities. Such personnel need to be given necessary input in the form of technical skill and refresher courses.

Some of the requirements considered necessary for fire fighters are as follows:

General requirements

1. Minimum Educational requirement
2. Professional training
3. Medical check up
4. Physical fitness
5. Heavy vehicle driving licence

Job Requirements

1. Use of communication systems
2. Rescue operations
3. Fire fighting techniques
4. Knowledge of materials / chemicals handled in the plant and their hazards
5. Use / Maintenance of various PPEs / Fire fighting equipment / vehicles
6. Ability to render First Aid

10.0 CRITICAL SCENARIO

In petroleum installations like crude oil production sites, gas processing plants, refineries, pipelines and marketing installations emergency preparedness plans / Disaster Management Plans are prepared in accordance with the prevailing statutory requirements, keeping in view major scenario of accident / fire / explosion / toxic release etc.

In any installation, there are certain facilities / plants which may pose a challenge to the Fire & Safety personnel while handling emergency situations like fire, explosion, toxic release, accident , rescue operations etc. Such facilities may have difficult approach from the road, multiple floors, confined spaces, in-adequate fire fighting facilities, poor ventilation, presence of other hazards like chemicals, electrical equipment etc.

Handling of such situations may call for specific equipment, fire fighting agents, techniques, adequate no. of trained personnel, vehicles etc.

Therefore, it necessary to study the plant facilities in detail and chalk out strategies to combat with the situations.

To meet the above, following approach should be adopted:

a) Study the plant / facilities from construction / layout / approach view point

b) Study the associated operation / maintenance practices / communication facilities and practices

c) Study the hazards present / precautions needed / existing suitable measures

d) Look for occupancy / their safety awareness / capability / supervision in case of emergency etc.

After identifying critical locations, detailed plans should be prepared so as to handle various emergency situations. Such plans should invariably include roles & responsibilities of all concerned.

Periodically, mock drills should be conducted to check adequacy of the plans and necessary

modifications should be carried out in the plans to over come short comings.

11.0 TYPICAL FIRE FIGHTING STRATEGIES

11.1 TANK FIRE

Before attempting to extinguish fire in the tank, fire in the surrounding area i.e. in the dyke should be extinguished to reduce heat input to tank contents. Cooling the adjacent tanks (contents of which have not ignited but are exposed to radiation heat) by means of water spray/jet applied to shell to prevent excessive vaporization and to reduce the danger of fire spreading to other areas. Application of foam on seal of adjacent tank is also required.

When burning, crude oils and asphalt develop a heat wave which travels downwards at a rate of 15 to 50 inches/hr. Temperature of oil may reach 260 to 315 0C. When this heat wave reaches to the tank bottom, where some settled water is generally present, it will cause a violent "Boil-Over." Burning oil first erupts and then falls, spreading even beyond the dyke of the tank. The columns of the flame can be very widely spread at the base. The beginning of a boil over is indicated by both increase in height and in brightness of the flames prior to actual eruption of the boiling oil. Immediate action will have to be taken to evacuate all personnel from the affected area and nearby areas. A "boil over" is a violent eruption. A boil over results from expansion or frothing of the heated liquid but is not as severe as a boil-over.

Heat-Wave

In case of wide boiling range ingredients in crude oil or product tank on fire, the lower boiling point hydrocarbons come out of the surface and feed the fire, while the higher boiling point hydrocarbons sink towards bottom forming a heated front to heat cold oil deeper and deeper as fire continues to burn. This phenomenon is called "heat wave."

In case fire is not put out by the time heat wave has reached the point, 5 feet above known bottom water level (which can be roughly judged by peeling off/blistering of the external painting of the tank shell), it is to be ensured that all personnel are evacuated from the area. Be on guard from successive boil overs form a burning tank since this will often occur.

Conduct all necessary work within the dyke area during the initial stages of the fire so that as the fire progresses, fire fighting operation can be carried out from a safer distance. Care must be taken NOT to get water in a heavy oil tank while fighting a fire thus reducing the possibility of boil-over.

11.1.1 Fixed roof tank fire

Light to Heavy Oils (except Asphalt)

1. Extinguish fires in the Tank dyke with foam to reduce heat input to tank contents.
2. Actuate spray system (wherever provided)/apply cooling water streams to tanks shell. Ensure that water does not enter into the tank either from run-off or from the water stream since it will destroy the foam blanket.

3. Apply foam inside the tank either through fixed foam chamber connections or through other available equipment.

4. Apply cooling water/actuate fixed spray/deluge system to other adjoining tanks exposed to radiation heat from fire.

5. Open tank dyke valves, as necessary, to avoid flooding of the tank dykes. However, care has to be exercised not to spread hydrocarbons to surrounding areas.

Asphalt tanks

Asphalt tanks are heated and operated at temperatures above 150 deg. C and therefore foam cannot be used in these tanks. Precaution should also be taken while using water to cool the shell so that no water enters into the tank. When ever possible water stream should be directed for fighting asphalt Fire.

11.1.2 Floating roof tank fire

Floating roof tanks are designed to eliminate open oil surfaces from which vapours escape. Since open surfaces are eliminated in most instances, the possibility of fire from static electricity charge is prevented as long as the roof is floating. A few rim fires are reported to have occurred to floating roof tanks from lightening and also when seals were in poor condition or improper channeled contacts between the roof and the shell of the tank.

Fire around roof edge

1. Floating roof rim fires should be extinguished by applying foam through fixed foam system or through foam branch from the top platform. Fire fighting personnel should not go down on the floating roof of a partially filled tank except in extreme circumstances. In case it as absolutely necessary proper safety appliances such as safety belt, life line, and fire suit must be used.

2. Actuate cooling water spray system/apply water jet streams on the affected tank as well as adjacent tanks as required. However, precaution should be taken to avoid water stagnation on the floating roof since it may cause the float unbalanced. Avoid directing heavy streams of water into the flammable material of the roof edge. This may splash burning product into the roof and increase the seriousness of the fire.

3. Open Tank dyke drain valves as required to avoid flooding of the dyke area. Care should be taken not to spread hydrocarbons to surrounding areas.

11.2 LIQUEFIED PETROLEUM GAS FIRE

Liquefied Petroleum Gas (LPG) is kept in liquid form by its own vapour pressure. LPG when released from this pressure rapidly becomes vapour which in turn is mixed in the air and forms an explosive mixture (Explosive range is 1.9 to 9.5 parts vapour mixed volume with 98.1 to 90.5 parts of air). A heavy leakage of the LPG may form a vapour cloud

which can travel as far as 1500m Whereas vapour from the open surfaces of gasoline have not been known to travel beyond 50m distances.

Following precautions / guidelines may be adopted to control LPG leaks & fires.

1. Approach the fire or gas leak from upwind. All fires (Process Heaters etc.), down wind of leak should be put off/extinguished.
2. Keep all persons out of vapour cloud area. Evacuate area which is in the path of vapour cloud as quickly as possible.
3. In case escaping LPG is not on fire, activate ROV to cut off source of LPG.
4. Water spray is effective in dispersing LPG vapours. Spray stream should be directed across the normal vapour path.
5. Controlled burning of escaping LPG is normally accepted as fire fighting practice. Application of sufficient water, to keep the shell of the vessel and piping cool, will allow the fire to consume the products without danger of causing failure. It is desirable where the leakages cannot be controlled after extinguishing fire.
6. Dry chemical powder is effective for extinguishing small LPG fires. Extinguishing agent should be directed toward point of vapour discharge.

11.2.1 L.P.G. Storage Vessel Fire

1. Do not extinguish flame except by fuel elimination, because accumulation of leaking gas can result in an explosion due to accidental ignition.
2. Stop movement of product to/from the tank by activating ROVs etc.
3. Apply cooling water by activating Deluge/sprinkler system and also water monitors.
4. In case of fire in the bottom section, apply water, stream through fixed/mobile water monitors to piping assembly/supporting structure. Water cooling should be done on the adjacent storage vessels.
5. Water cooling on the affected vessel should be continued even after flame extinguishment until all danger of the re-ignition from the hot surfaces or other sources has been eliminated.
6. Water spray protection for fire fighters should be provided on a continuous basis as long the danger of vapour cloud persists.
7. If possible, pump water into the vessel to float the flammable material above the leaking point in the shell. This would extinguish the flames if water pumping rate exceeds the rate of leakage.
8. Should a shell failure occur below the liquid level of the tank and result in leakage which exceeds the capacity of the water pumping facilities, several solid streams of water should be directed on the shell surrounding the leak. Try to form a curtain of water spray and maintain it until

any flammable material i.e. LPG has been consumed and the vessel has become gas-free by natural ventilation or by the addition of steam to the vapour space of the tank.

8. Before plant operations are resumed after completion of fire fighting, gas test should be made in pits, trenches or dykes where gas or heavy vapours might accumulate. Portable gas detectors should be used to check presence of flammable gas. Similar precautions and fire fighting operation is to be followed in case of fire in LPG Recovery Unit.

11.3 RAIL TANK WAGON FIRE

(Liquid Fire)

1. Stop all loading/unloading operations in the area and isolate the respective lines.
2. Close the domes of all unaffected wagons as far as possible.
3. Isolate the tanker on fire from other tankers not involved in the fire by using water spray through hose lines.
4. Apply cooling water spray streams through hose lines/fixed water monitors to the fire affected wagon, adjacent wagons and other nearby equipment.
5. Remove unaffected tank wagons from the fire areas as quickly as possible. Use water screen for protection against radiation for undertaking wagon removal or other operations.
6. Extinguish all ground fires before attempting to extinguish the fire on tanker.
7. After containing the fire on the tanker, use foam or dry chemical for extinguishment, water spray to be continued for some time after the fire has been extinguished to prevent reignition.
8. Salvage as much un-burnt liquid as possible.

In case of LPG tank wagons, similar precautions as of LPG storage vessels should be followed, whenever possible. However, DCP is to be only used to extinguish the fire and water for cooling.

11.4 ROAD TANKER FIRE

1. Stop all pumping/loading operations.
2. Close block valves on pipelines to tanks as well as loading lines to gantry.
3. Isolate the burning tanker from other tank trucks, not yet involved in the fire.
4. Apply cooling water spray from fixed water monitors as well as hose lines to cool the tank trucks completely.
5. Protect adjacent refinery equipment and other tank trucks with cooling water stream.

6. When the fire is contained with the help of water spray streams, apply foam to extinguish the flames. Cooling streams should be maintained even after flame extinguishment until all danger of re-ignition from hot surfaces has been eliminated.

▪ 7. Salvage as much un-burnt oil as possible.

For additional information, refer OISD-STD-161 / 165.

In case of L.P.G. tank trucks, similar precautions as under L.P.G. storage vessels should be followed whenever possible. DCP to be only used to extinguish the fire.

11.5 PROCESS UNIT FIRE

Process unit fires are extinguished principally by fuel removal. This is accomplished by making operational changes to reduce pressure, by introducing steam to the affected systems and by blowing down sections of the unit as required.

The area and intensity of a fire will indicate the proper method of extinguishment. Small fires can be combated with dry chemical powder,CO2, steam or foam. Foam should be used only where it can blanket the burning fuel. Water in the form of spray or high pressure fog is most effective on large area of intense fire that threaten damage to supporting structures and adjacent equipment. However the use of water may cause flanges and joints to leak due to thermal shock there by adding fuel to the fire. Adjusting the water stream to spray or fog will lessen this danger.

11.5.1 Relief valve vent fire

Make necessary operational changes particularly the following:

(a) Open drain line from the vent line to make sure that all the oil is drained.

(b) Cut steam to the vent.

(c) If there is evidence that a relief valve has opened and will not re-set, proceed to take the equipment out of service and depressurise.

(d) If liquid hydrocarbon overflows through the vent, apply high pressure water fog working upwards from the lowest flames.

(e) Apply water spray to the entire structure engulfed in flame at point of advantage around the base of the structure to prevent heat damage to structural members.

11.5.2 Exchanger or transfer line fires

In most cases exchanger and transfer line fires are the result of abrupt changes in temperature / pressure. Therefore

(a) Make an effort to re-establish the normal operating temperature at the equipment.

(b) If the normal operating temperature cannot operating make efforts

to reduce pressure on the equipment.

(c) Apply steam, dry powder or carbon dioxide (preferably steam) to the point of leakage.

(d) If the fire can not be extinguished by use of portable equipment, apply high pressure water spray to the immediate vicinity of the leak.

(e) Protect structures and lines on which fire is impinging by applying water spray from monitor/hand-lines.

(f) Apply foam on ground/trenches in which burning oil may accumulate; covering the sewer drain to prevent fire entering the sewers.

(g) Avoid working above sewer drains or near fire traps since there is a possibility of explosion.

(h) Maintain adequate drainage of fire area.

11.5.3 Electrical Machinery fires

(a) Operators should start the standby machine, if possible, and machinery on fire to be switched off.

(b) CAUTION: Do not use water or foam.

(c) De-energise the circuit if possible.

(d) Apply carbon-dioxide or dry powder, Halon / Halon alternatives to extinguish the fire.

11.6 FIRE INVOLVING SULPHUR

- Use either water in the form of spray or sand.
- Do not disturb the fire by using a water jet.
  - CO2 or DCP fire extinguishers can also be used to extinguish sulphur fire.
  - For storage pit containing molten sulphur, steam or inert system is suitable.

11.7 PUMP AND COMPRESSOR FIRE

(a) Operators should start immediately the standby machines. If this is not possible, operation should be adjusted to take the affected machine out of service and isolate it. Drain or de-pressurise the equipment and connecting lines, if conditions permit.

(b) Apply steam or dry powder from portable extinguishers to the leak.

(c) If portable extinguishers are inadequate, blanket the fire area with water spray and direct jets of high pressure water fog into the source of fuel until the operators have succeeded in stopping the flow of fuel.

(d) Apply foam on the ground/trenches in which burning oil may accumulate covering the sewer drain to prevent fire entering the sewers.

(e) Avoid working above sewer drains or near fire traps.

(f) Maintain adequate drainage of fire area.

11.8 TRENCH OR PIT FIRE

(a) Operators should check immediately to locate and stop the source of leakage into the trench or pit.

(b) Apply steam, CO2 or dry powder to the fire area. If this is not successful, apply foam covering the sewer drain as possible.

(c) Apply high pressure water fog or water spray to prevent damage to adjacent equipment.

(d) Avoid overflowing trenches or pits with water since this may cause spread of fire.

(e) Avoid working above sewer drains or near fire traps.

11.9 FURNACE HEADER OR TUBE RUPTURE FIRE

A header box fire is normally the result of a radical operating change. Injection of steam into the header box will usually extinguish a fire. If it is of significant size and can not be extinguished with steam, this fire must be treated as a tube rupture fire.

11.9.1 Tube rupture fire

(a) Take necessary action to remove hydrocarbon by isolating and/or depressurising.

(b) Inject steam into furnace tubes.

(c) Inject steam into fire box and header box.

(d) Protect structural members outside the fire box threatened by flame with water spray.

(e) Do not use foam. It is ineffective on this type of fire and will result only in waste.

11.10 SEWER FIRE

(a) In most cases, a sewer fire may follow a sewer explosion. In such a case the operator should see that steam from steam hoses is directed at sewer outlets in all gaseous areas. If there is a sewer fire, be sure that no one is standing or working on or near the sewer outlets.

(b) Apply dry powder at each manhole or drain from which flame is issuing.

(c) Direct water streams into involved trenches to maintain flow towards the fire area. If there is oil on the water in the trenches, use foam.

11.11 SPILL FIRES - ABOVE GROUND LEVEL

(a) Operators should immediately determine the source of leakage or spill and stop it if possible. The particular piece of equipment involved should be taken out of service,

depressurised and steamed, if necessary.

(b) Blanket small fire areas with steam or dry powder but avoid scattering of burning material.

(c) Blanket large fire areas with water spray from monitors, fire hydrants to protect supporting structures. Maintain water flow until operators control the flow of fuel.

(d) If quantities of oil are flushed to lower levels and continue to burn in pools apply foam to these.

(e) Maintain adequate drainage of the fire area.

(f) Avoid working above sewer drains or near fire traps.

11.12 SPILL FIRE - GROUND LEVEL

(a) Operators should determine the source of leakage or spill immediately and stop it, if possible. If is a continuous leakage which can not stopped, the particular piece of equipment involved should be taken out of service, depressurised and steamed, if necessary.

(b) Blanket small fires with steam or dry powder but avoid scattering burning materials.

(c) In case of large spill fire, direct high pressure water fog into the source of leakage. Protect surrounding structures with water spray. Maintain the water flow unit the operators control the flow of fuel.

(d) Apply foam to extinguish fires in oil pools or trenches.

(e) Maintain adequate drainage of the fire area.

Caution

Avoid working above sewer drains or near fire traps.

11.13 LABORATORY FIRE

This type of fire requires different combatting procedures because of glass-ware and special types of apparatus and equipment involved.

(a) Use carbon-di-oxide, Halon / Halon alternatives, DCP portable extinguishers on small fires.

(b) In case of large spills of flammable material whether ignited or not, evacuate personnel from the building and cut off fuel, air gas and electrical services to the building. Cut off any other outside source of fuel.

(c) Use water fog or water spray only on fires which threaten damage to the building structure.

(d) Do not enter a smoke filled area without respiratory protection. Laboratory supplies include many chemicals which may emit toxic vapours when exposed to fire.

REFERENCES

1. OISD-STD-116
2. OISD-STD-117
3. OISD-STD-142
4. OISD-STD-155
5. OISD-STD-169
6. Indian Standard IS-5131
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14. Indian Standard IS-1206
15. Indian Standard IS-7959
16. Indian Standard IS-4308
17. Indian Standard IS-2171
18. Indian Standard IS-4947
19. Indian Standard IS-8442
20. API 2001